THE MODEL ENGINEER

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THE MODEL ENGINEER

EVERY THURSDAY

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Our Cover Picture

The photograph on the cover this week was sent in by a Beckenham reader and depicts Mr. B. A. Lewis, also of Beckenham, in his workshop. Mr. Lewis, we understand, is at present engaged on the construction of a scale river police patrol boat powered by a small internal combustion engine, and at the time when the photograph was taken was turning part of the silencing system for the engine.

The boat is now completed and awaiting trials, and if all goes well, it will be equipped with radio control.

The lathe in use is one of the older $3\frac{1}{2}$ in. Drummond machines. It has recently been motorised and in spite of its age continues to give good service.

Mr. Lewis exhibited at "The Model Engineer" Exhibition two years ago a nicely finished model of a 10 c.c. Ensign engine designed by Mr. E. T. Westbury, and he hopes to be able to enter his patrol boat in the next exhibition.

SMOKE RINGS

Our New Dress

● WE HOPE that the new style which THE MODEL ENGINEER has, at long last, adopted will meet with general approval. We do not expect that it will please everybody; no change ever did! But the present format—let us be quite frank about it—not only eases the problem of filling a limited amount of space to the best advantage, especially with regard to illustrations, but it results in a generally neater arrangement.

The more colourful cover finally gets rid of any suggestion of the wartime austerity, and we hope that it may be looked upon as a harbinger of a brighter era ahead. With this issue we begin our fifty-fifth year; during the past fifty-four years, THE MODEL ENGINEER has stood supreme in its particular field, and we intend to keep it so.

Incidentally, the attention of readers is drawn to the address given above. We are in the process of moving to new and more commodious offices than those we had in Great Queen Street.

Cover-pictures

● THE NEW shape of THE MODEL ENGINEER has altered the shape of the illustrations we use as cover-pictures; instead of the upright sort hitherto used, we have adopted the style seen on the cover of this issue. If readers possess any suitable pictures of this shape, we are prepared to consider them and to pay for any that we use.

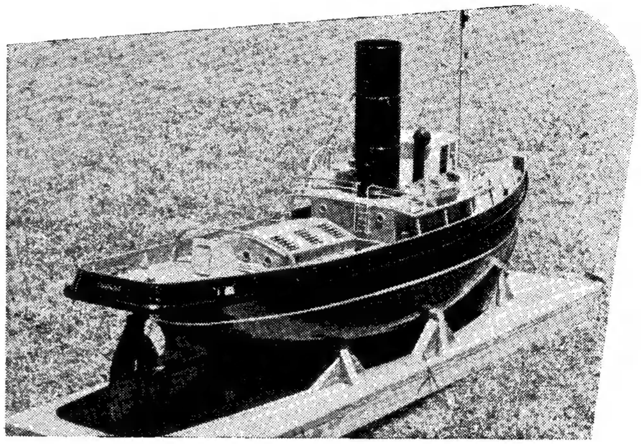
The subjects may be anything that comes within our scope, and we have no objection to the inclusion of the "human element," so long as it does not dominate the whole scene. But we would emphasise that photographs which show either a man admiring a model he has built, or a fine model surrounded by small children, are definitely *not* wanted. A scene like that on our cover of October 23rd last, however, is an excellent example of what we *do* like; but the original picture for that one was taken by one of our own staff, so it could hardly be wrong! He had to wait and watch patiently for a very long time before he got it. Incidentally, prints submitted should be, preferably slightly larger than the reproduction.

Winter in the Workshop

● THE COLD weather, which set in early this winter, and with unusual intensity, has brought with it a spate of queries on the ever-recurring problem of heating the workshop, and the prevention of rust. As we have so often pointed out, these problems are interconnected and indeed inseparable, and they have been discussed so much in the past that the topic is well-nigh exhausted. There is no doubt whatever that comfort in the workshop is a very important factor in producing good work; not only is it impossible to manipulate tools properly with numbed hands, but the prospect of going out into a cold workshop to start work is a powerful deterrent to activity, and it needs a great deal of moral courage to forsake the comfort of the fireside on a chilly evening. As many of our readers have found to their cost, however, it is by no means an easy problem to keep the workshop warm; if an oil stove or open gas fire is used for heating, the products of combustion, in conjunction with rapid rise in air temperature is a prolific cause of condensation, resulting in rusting of tools and machines despite all precautions against it. Dry and gradual heating, as produced by slow combustion stoves, low-temperature electric heaters, or central heating, is much to be preferred in this respect, though not entirely free from the above ill effects. Wherever possible, one should aim at keeping the temperature of the workshop fairly even, or at least avoid rapid temperature changes.

Reconstructing a

MODEL STEAM TUG



By G. D. Edmeston

(Australia)

SOME years ago I built the original version of the tug boat which I am describing here. I made so many errors in design and workmanship in the first attempt that I will give a brief description of the original boat, and also the power-plant in the hope that they may be of some guide to tyros in this class of model engineering. I had better state here that all that now remains of the old boat is the hull and false keel.

The hull was made from American red pine obtained dressed in three pieces 5 ft. × 12 in. × 3 in. The two upper sections were hollowed out with the aid of a key-hole saw and various chisels. All the three pieces were screwed together and located accurately with small pegs and finally were glued together with ordinary joiners' glue into which was poured an 8 oz. bottle of acetic acid to render it waterproof. The bulwarks and superstructure were made entirely of $\frac{3}{16}$-ply and pine wood and proved unsuitable especially in relation to scale and to the difficulty in securing and fixing. The deck was made from $\frac{3}{16}$-in. hardwood ply in one piece and has proved an excellent medium when properly varnished and secured to deck beams. Lined with a blunt scriber and then pencil the appearance is most realistic.

The engine installed was built mostly from scrap material, cylinder 1 in. × $1\frac{5}{16}$-in. stroke (single) in cast-iron and measured in height—hold your breath—$8\frac{1}{2}$ in.! This excessive height came about by my ridiculous demand for a long conrod. The c.i. cylinder was a bad choice as when subsequently dismantled the pitting and rust in the cylinder and valve face were a sorry sight. A displacement lubricator was fitted, but I cannot very well say if it was satisfactory or otherwise. Sufficient to say that any future engines that I may build to run on superheated steam will have "L.B.S.C's" pet lubricator. I had to build a deck house over this cylinder as the top projected some 2 in. or more above the deck. The boiler was a single drum water tube with six $\frac{3}{8}$-in. tubes housed in a steel casing which rusted very badly in the course of years. With a noisy primus burner this boiler would steam the engine continuously, driving a propeller (three bladed) $4\frac{1}{2}$ in. diameter, pitch about 6 to 7 in., at about 300 r.p.m., producing a speed of about 5 m.p.h. The worst defect of this boiler, like the engine, was its height which was 10 in. This came about by using an ordinary primus burner. This excessive height in conjunction with the heavy gauge steel of the boiler casing were the cause of much heart-burning when testing the boat's stability. Another bad feature was the lack of forethought in erecting the superstructure which permanently enclosed the boiler, water tank and kerosene tank, so that attention to any of these required that the upper works had to be forcibly removed. The funnel was made from $2\frac{1}{2}$ in. brass pipe which probably weighed about 2 lb. As will be anticipated the boat promptly capsized on launching. The removal of about 3 in. from the top of the funnel made a surprising improvement in stability, though it left the appearance unlike any tug I had ever seen. Putting in about 7 lb. of ballast right on the keel finally brought her to a stable condition. No model ship, no matter how well made, looks well with poor paintwork and the hull on my tug was rubbed down and repainted many times before it lost that treacle-like finish it originally had. The boat in the condition as described ran well for a number of years and presented a fine sight steaming in open water leaving a clearly visible wake well astern.

Most of her sailing was done in salt water which made the task of keeping the water tank topped up rather strenuous—having a rather small tank and a heavy thirst. The duration of the voyages was about three hours, the boat being released in a small circle which was gradually increased by altering the rudder setting till she was sailing in a circle about 150 ft. in diameter. This method was quite reliable provided the weather was calm.

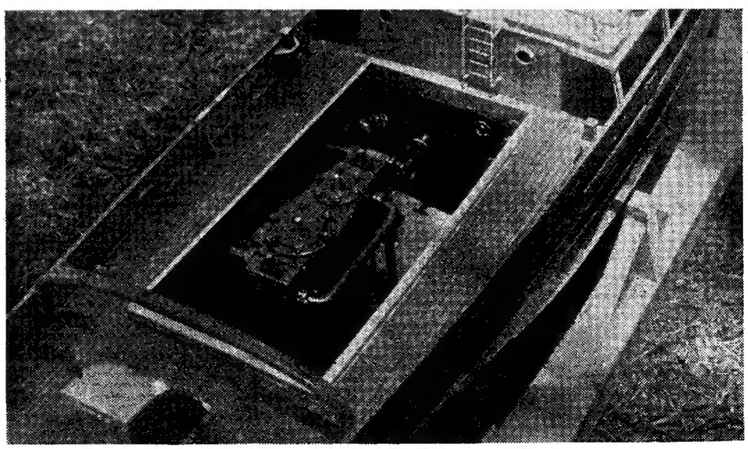
One Sunday morning before the war the engine was dismantled with the idea of correcting a small amount of blow past the piston. As stated previously the sight that greeted me on removing the covers was rather upsetting and it was obvious that something drastic would have to be done. A new engine altogether seemed to be the ticket. This obviously was the opportunity to benefit from the defects and shortcomings of the original plant. This I decided to do with the following improvements in mind: (1) To make an engine that would look something like the real thing; (2) To make it powerful and yet economical in its demand on the boiler; (3) Approximately of scale height; (4) Easy to detach for cleaning; (5) Provision for power-driven feed pump and also positive lubrication (features lacking originally). From conditions 1 and 2 it is not surprising that I finally decided on a compound. Naturally, the question of fitting condenser and air pump were very seriously considered, but with regard for the engine room available and the number of pipe connections requiring to be unconnected in removing the engine after a run I decided against it. I made drawings to full size and patterns for the cylinders, chests and bedplate,

which were all cast in gunmetal. H.P. $\frac{3}{8}$ in. dia., L.P. $1\frac{5}{16}$ in. dia., stroke $1\frac{5}{16}$ in. Being a tug the valve gear should be reversible but as the model was to be a working "live steamer" this was discarded in favour of simple eccentrics for its simplicity and robustness. The final valve setting, after some experimenting under steam was unfortunately, without a load, but as follows :—H.P. 60 per cent. cut-off, L.P. 80 per cent. cut-off. This is as near as I can judge it now, the original details having been lost. The pistons were turned from phosphor-bronze and were finished $\frac{1}{2}$ in. in depth with two packing rings $\frac{3}{16}$ in. wide and $\frac{1}{8}$ in. deep. The H.P. piston was built up hollow and silver-soldered together for lightness. The porting on the valve face was H.P. 3/32 in. $\times$ $\frac{1}{2}$ in. steam. $\frac{1}{8}$ in. $\times$ $\frac{1}{2}$ in. ex. L.P. $\frac{1}{8}$ in. $\times$ $\frac{5}{8}$ in. steam. $\frac{1}{4}$ in. $\times$ $\frac{5}{8}$ in. ex. The bedplate has five bearings with adjustable caps bored $\frac{3}{8}$ in. dia. for the crankshaft. This casting was machined with a special boring bar running between centres. The crossheads were built up in steel and envelope a rectangular guide bar in similar fashion to steam launch engines. As I have never had much success in bending copper pipe the transfer and exhaust pipes stimulated some thought, owing to the small-radius bends required. I eventually did this job by cutting out small wedges of tube on the inside of the bend with a jewellers' saw and then bending the tube and brazing the saw cuts with brass wire. This made a good job when filed and polished up. The boiler feed pump, $\frac{1}{4}$ in. bore $\times$ $\frac{5}{16}$ in. stroke, was positioned to imitate the air pump and is operated from the L.P. crosshead. The L.P. cylinder exhausts into a condensate drum which needs to be drained off during running. I hope to remedy this latter detail as soon as possible. The "L.B.S.C." oil feed pump can be seen under the "condenser" and is driven off the "air pump" shaft and pumps oil (600 W vacuum) through a 3/32 in. brass pipe into the main steam pipe. The bed, and other parts, usually painted, were given several coats of grey enamel, which greatly improved the appearance of the engine. It was during the building of this engine that the ship itself came into the orbit of reconstruction. It happened very quickly. On another Sunday morning, when examining the boat, I realised that the engine was too good for such a roughly-built model. Without much consideration I made up my mind there and then to do the right thing by the engine, and by lunch time it was stripped down to the hull and I had visualised the new layout (and new boiler included). The very first thing I did was to rub down the paintwork with fine "wet or dry" sandpaper obtained from the local garage and repaint with thin coats of "Dulux," sanding each successive coat when thoroughly dry. The upper hull is painted black and the lower dark green "Dulux" (larch green) with a thin white water line. The latter was done by gumming paper strips around the hull as a mask. When thoroughly dry the hull was given a fine finish by rubbing with "Duco" cutting wax applied with a rag and plenty of elbow grease. Experts may criticise this high finish, but its durability is better than these dead matt paints and it cleans very easily.

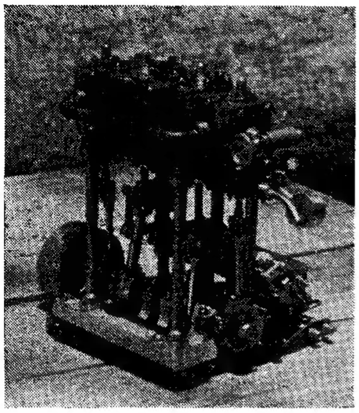
A new propeller shaft, $\frac{3}{8}$ in. dia., was made and fitted into the old tube $\frac{5}{8}$ in. dia. and a ball-bearing thrust added to replace the old plain collar thrust. The old propeller was scrapped and a new one made to a larger dia. (5 in.) and a greater pitch (about 8 in. or more). A new stern post and rudder to replace the original "toy" rudder and new deck beams were fitted and a new deck of $\frac{3}{16}$ in. ply. The bulwarks were made of 18-gauge steel in sections about 2 ft. long and the deck was recessed through one ply with a special tool to receive it. The deck extends beyond the hull to form the lower half of the rubbing strake.

All the superstructure was made from thin sheet iron, riveted and soldered. The windows in the wheelhouse were glazed with mica, held in position by soldering little brass strips around the edges. The lifeboats were made of paper glued on to a former and built up layer upon layer on a paste-board keel, seats being fitted when removed from the former. The funnel was rolled up from thin galvanised iron, riveted and soldered, the bands being 16-gauge copper wire soldered in position. The hand rails on the bridge deck are slightly over scale for robustness, the top rail being flattened $\frac{3}{16}$ in. copper tube drilled and tapped 3/32 in. Whit. to receive the stanchions, the lower ends of which project into the deck house and are soldered inside. The centre rails are fitted into grooves filed in the stanchions, bound with fine copper wire and soldered. The top half of the ventilators were once cups for holding gramophone needles. The stanchions holding the bridge deck to the bulwarks are "O" gauge brass rail.

The boiler was designed after a suitable type of burner was produced. It was desired that the burner should (1) be silent, (2) of minimum height, and (3) easy to start in its position under the boiler, and thoroughly reliable. This was produced by modifying a Primus type silent (stove) burner. The tubes were cut off close to the upper cap and the vaporising or "U" tube with the nipple was shortened by about $\frac{5}{16}$ in. and fitted back into its original holes in the upper cap. New $\frac{1}{4}$ in. feed pipes were fitted into the other holes and bent to allow the bottom of the vaporising tube to rest on the bottom of the boiler casing, and joined into a combining union. This reduced the overall height to less than 2 in. I found in using this burner that a larger nipple produced a much better flame without any danger of flooding.



Looking into the engine room of the model steam tug



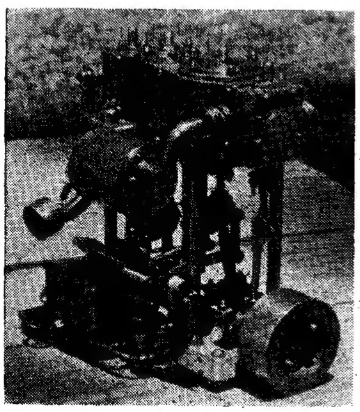
View of engine from aft, showing condenser and feed pump

The water-tube boiler was made with two 16-gauge copper drums, $2\frac{1}{4}$ in. dia. × 8 in. long (running fore and aft), with sixteen $\frac{3}{8}$ in. copper cross water tubes. A $\frac{3}{16}$ in. copper superheater runs the entire length of the boiler through the flame area. The casing is made of brass sheet (steel rusts badly down in the bilges) and lined with $\frac{1}{8}$ in. asbestos millboard. A hand feed pump was provided as an auxiliary with separate clack and feedwater heaters. A water tank of generous proportions was installed immediately forward of the boiler. The kerosene tank being right forward a filler oil release and pump was housed under a small hatch near the mast. The supply pipe from the tank terminates at a stop valve and union in the "engine room." This allows the burner to be disconnected for cleaning without flooding the bilges with fuel.

On the initial run of the power plant I confess that I was rather disappointed as I expected a two-cylinder compound to have four power impulses per rev. instead of only two. Subsequent running, however, threw a different light on my ideas of a compound. The original tests I made were by turning the engine over on a crack of throttle and with no load. Under running load the engine will run smoothly and slowly (if throttled back) provided the cylinders have had time to get hot, and most times is self-starting. To date I have not had the opportunity to launch the *Plucky* but as she will fit in our bath with about $1\frac{1}{2}$ ft. to spare I gave her a power test just the other day. I admit that I anticipated she would shift some water but on opening up the throttle with 50 lb. on the clock I got a surprise, as she nearly emptied the bath—on to the floor—the nearest thing to testing an outboard motor in the bath ! I was delighted with the power indicated. The cavitation and churning of water under the stern could be heard 100 yards away outside. No difficulty was found in keeping the boiler to 50 lb. under this load, though I did have trouble in keeping the water level in sight, and fiddling with the by-pass valve I had numerous burns on my wrists—the steam pipe being "blue pencil" hot. One minute the boiler was almost empty ; later, I had both safety-valves squirting water ceiling-wards. The engine revs. under conditions as described were approximately 200 r.p.m.

At a later date I propose to make *Plucky* do some real work pulling me around in a light row-boat—which I have no doubt she will do quite easily.

In answer to Inspector Meticulous —no, I have not yet fitted towing hook or life-belts.



View of engine from forward

THE BUXTON M.E.S. EXHIBITION

The society's latest exhibition proved to be the best effort yet. During the day and a half the show was open almost 3,000 people attended, a result which was very gratifying to all concerned. Altogether there were about 240 exhibits on view, the majority of which were supplied by club members.

Among the highlights was the Grand Prix model race car track operated by the Chapel-en-le-Frith Model Car Club ; this track was suitably embellished with motoring adverts, etc., and the noise, the smell and the general excitement made the whole affair very realistic. Needless to say, the room containing this outfit was packed to suffocation whenever the cars were running.

Mr. Slack's now well-known model roundabout was also much admired and was particularly popular with the ladies, its music lending a rather festive air to the general effect. The club's own gauge "O" track, supplemented by track uprooted from the home layouts of various members, was in continuous operation throughout the show, with steam, electric and clockwork locomotives. A new departure was the invitation to visitors to bring along gauge "O" locomotives to run on the track and this proved to be a very popular idea with the local youngsters. A small gauge "OO" layout also attracted considerable attention, traffic being stopped several times, owing to track faults caused by the pressing crowds. As usual, the passenger locomotives were very busy in the school yard, hauling endlessly repeated loads of children up and down the portable track.

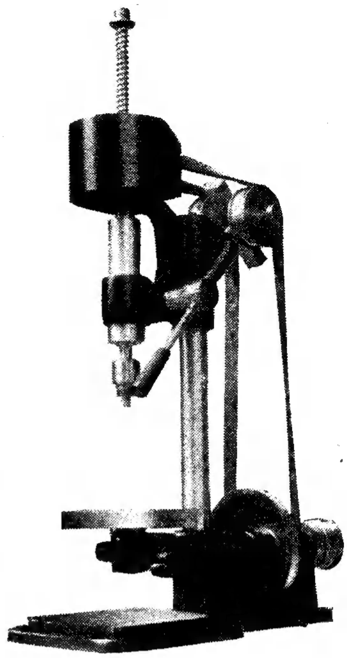
In one corner of the hall a lathe, drilling machine and tool grinder had been set up and during Saturday a lathe mandrel was produced for one of our younger members, who is busy with a home-built lathe. A very nice display of model ships was supplied by our friends in the Sheffield Ship Model Society and these were always the centre of an admiring group. As a change, we had a table with notice "Please Do Touch," and containing among other odd items a $2\frac{1}{2}$-in. gauge locomotive which was well and truly worked over by the youngsters. In addition, a harmonograph doodled incessantly during the whole period of the show, and two push-button locomotives, lent by British Railways, were also very popular.

Among the remaining exhibits may be mentioned weaving looms ; patterns, moulds and castings for a portable engine ; tools and machines in great variety, including a very effective-looking vertical miller ; locomotives, traction engines and stationary engines of many types and sizes ; a working model railway turntable with engine sheds ; a display of woodwork by the boys of the local Modern School and an electrically-heated boiler and steam engine which buzzed away merrily.

We were pleased to meet again and talk to our friends from other towns and societies, and we sincerely thank all those who helped to make the Exhibition the success it was.

A high-speed sensitive drilling machine

By the Rev. Arthur Mellows



IT is very natural that there should be a considerable divergence of opinion among model makers about the design of small machine tools. The correspondence columns of THE MODEL ENGINEER frequently contain letters dealing with this subject—sometimes in a vivid and picturesque way. Doubtless that hardy annual, the design of the ideal lathe, will flower again to our amusement and profit—and we hope to the encouragement of the machine tool industry to get busy and produce something more like the ideal than we have had hitherto.

In the meantime I invite my fellow readers to share with me some experiences in the construction of a drilling machine which attempts to be a cut above the average both in looks, accuracy and performance.

This machine is my second attempt. The first machine was made up from a set of castings which had a wide sale some years ago, and I am bound to say that the little machine has served me well. It has drilled thousands of holes and it still contains the promise of years of useful service for someone else. But the machine was not my own design. Moreover, using it was never accompanied by that feeling of pleasure which I believe is wrapped up with working with a good tool. Somehow I always had the feeling that the machine was being pushed—like driving a car which is overloaded or out of trim. There were other faults, some due to design, some to my lack of skill in building. So in the end my dissatisfaction grew and the machine had to go.

Before the new machine took shape upon the drawing board the following preliminary considerations were decided upon :

(1) The machine must be capable of drilling holes in bronze, steel and iron with high-speed twist drills from 0.025 in. dia. to 0.312 in. dia., and at no point in this range must its ability be strained. It must possess enough power, speed and sensitivity to drill these sizes with ease.

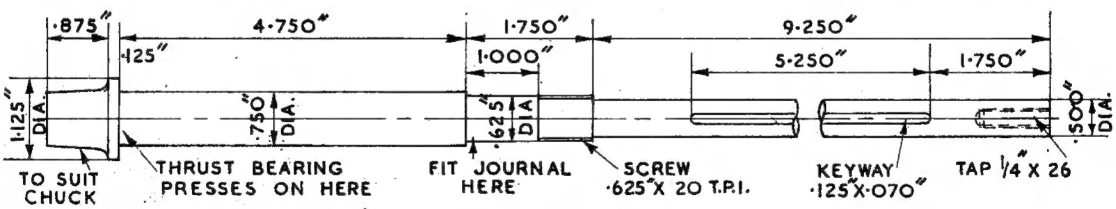
(2) Its accuracy must be unquestionable. It must be rigid enough to withstand all working stresses, and sufficiently simple to ensure alignment tests to the following limits :

- (a) Spindle and column to be parallel to within 0.0005 in.
- (b) Column to be square with base to within 0.0005 in.
- (c) Drill point to run true at all sizes to within 0.0005 in.
- (d) Movable table to be square with column to within 0.0005 in.
- (e) Vibration at highest speed to be nil.

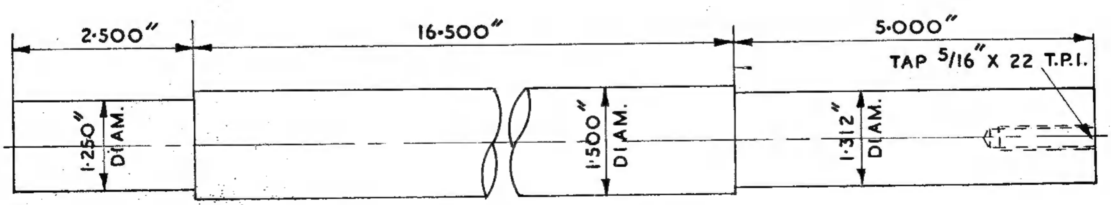
(3) Except for the baseplate, all machining to be done upon a 4 in. lathe.

(4) The machine when finished must not only be suitable for use in the home workshop, but also be suitable for making as a high-class machine tool for school workshops and technical colleges, and, therefore, must be capable of hard work with the minimum of servicing.

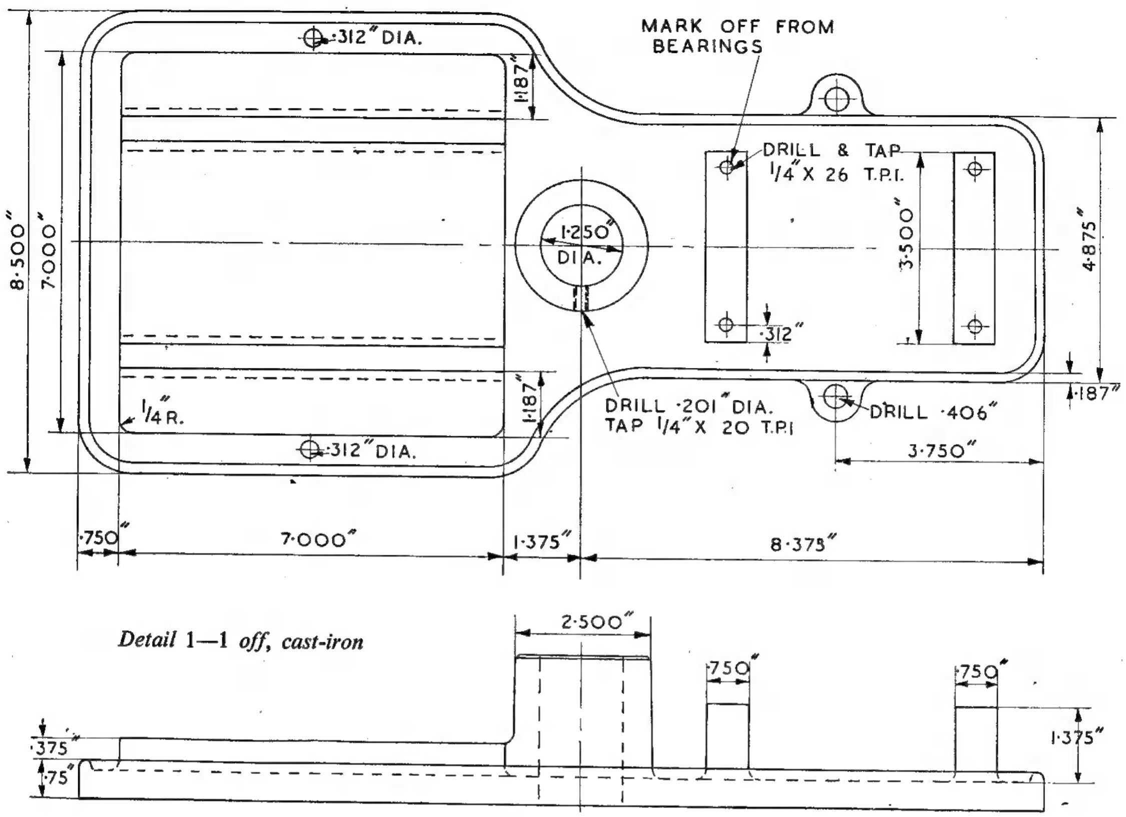
Now it will be seen that I have



Detail 5—1 off, nickel chrome



Detail 2—1 off, nickel steel



Detail 1—1 *off, cast-iron*

limited the capacity of the machine at the lower and upper ends of the scale of drill sizes, and I have done this deliberately. Quite a different technique is required to drill holes less than 0.025 in. dia.; and a heavier machine would be needed for holes over 0.312 in. Moreover, the difference in speeds required is so great that it would be well-nigh impossible to make a machine which would be satisfactory at all drill sizes. Glowing paragraphs of three-speed machines which will drill from 0-½ in. or over mean nothing to the man who knows about drilling. The machine is not made that will do it well.

Given a countershaft speed of 1,000 r.p.m., the slowest speed is approximately 720 r.p.m., which is quite suitable for drilling 0.312 in. dia. holes in either iron or steel; the second speed is 1,550 r.p.m. which is suited to drills from 0.250-0.125 dia.; the top speed is 3,400 r.p.m., which is slow for the smaller drills but high enough to do the job in a practical manner.

Now these speeds meant that frictional losses must be kept at a minimum. It was decided, therefore, to use ball-bearings at *every* point. This makes the machine somewhat expensive to build.

From the detailed drawings it will be seen that three bearings are used in the spindle; one is of the light thrust type, and the other two are journals. Two races are used in the jockey pulleys, two in the countershaft bearings and two in the loose pulley. This makes nine ball-races in all—which is rather a tall order, but the results more than justify the extravagance. At high speed the machine is as steady as a rock, and is silent except for the pleasing hum. Moreover, it drills the smaller sizes with ease.

So much for preliminary considerations. We will now turn to the actual making of the machine, and in the notes which follow I will attempt to make the way clear for any other amateur who may like to attempt a similar task.

The patterns were quite easily made and required very little timber; they were all designed to be cast without core boxes. The bores in the baseplate, and the bores for both spindle sleeve and column in the headstock were cored to allow of the ready insertion of the boring bar, but all the other bosses were cast solid. The photograph of the patterns will give a clear idea of the straightforwardness of the jobs involved.

To those who wish to build a similar machine I would, however, offer the following advice: Use well-seasoned wood and spend extra time on getting a really smooth surface. Round off all sharp corners and provide a slight taper on all verticals to allow for "draw" out of the sand. Give at least four coats of varnish (black for the parts required to be cast, red for the cores). This varnish is easily prepared by mixing lampblack or red ochre with french polish. Between each coat rub down with fine glass paper. The smoother the finish on the patterns the better will be the skin of the iron. Meehanite "C" would be an ideal iron for the castings; failing this, specify a fine grain grey iron.

The baseplate was machined in the workshop of the local technical college by the courtesy of the Principal, but the remaining work was done upon my 4 in. lathe;

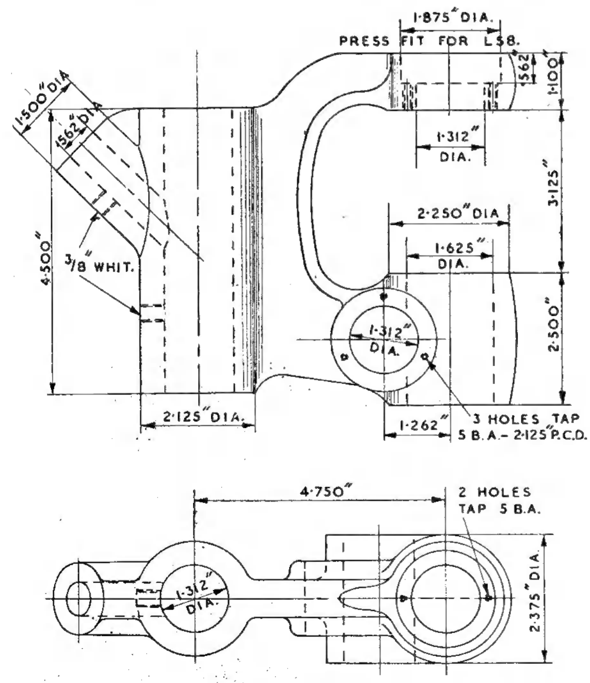
none of it taxed the machine's capacity to the full, although some of it necessitated the making of special tools in order to achieve the degree of accuracy required.

The boring of the headstock was the heaviest job. The casting was first fettled and "proof inspected," and a centre-line scribed all round, the casting being set up on tool-room jacks upon the surface-plate. Next, one face of the boss for carrying the rack pinion spindle was filed up flat and a 0.531 in. dia. hole drilled through the centre of the boss. The casting was then bolted to the boring table of the lathe, being packed up on parallels until the scribed centre-line was at the exact centre height of the lathe. The hole for the column was then roughed out to within 0.025 in. of size; and a note was made of the reading upon the micrometer collar of the cross-slide. Then the table was moved over exactly 4.750 in. and the boring bar inserted in the second cored hole. This second hole was then finished to the sizes shown in the drawing, especial care being taken to get the diameter of the pulley bearing boss a light press fit for the ball-race Hoffmann LS8. The four faces of the bosses were then faced square and to size, and the boring bar extracted. The cross-slide was then moved back 4.750 in. to the previously noted index and the hole for the column was finished to its correct diameter. This method, although taking a little longer time, made sure of the parallelism of the two bores. The limit allowed was "to within 0.0005 in.; the most careful checking, however, has failed to discover any measurable discrepancy. The casting was then set up vertically, resting on parallels underneath the bottom face of the spindle boss. In this case the centre-line of the rack spindle boss was made to coincide with the centre-line of the lathe. The 0.531 in. dia. hole was then opened out by drill and boring bar to 1.312 in. dia., a check being made to see that enough clearance was left to allow for bringing the rack pinion into mesh with the rack. All the other work upon this casting was then done. It was all simple drilling and reaming, and calls for no explanation. One point, however, should be watched by those who build a similar machine: it is of importance that the 0.625 in. dia. hole which forms the bearing for the belt-tensioning device should be at 45 deg. If this is at another angle, correct tensioning and alignment of the belt will be impossible on all three speeds.

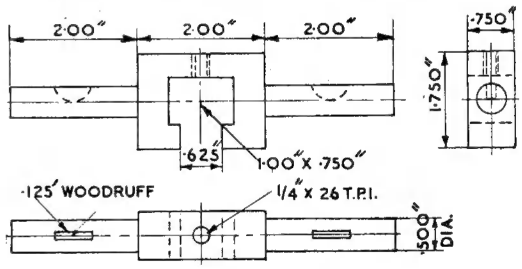
The column is a length of ground nickel-steel (1.500 in. dia.) and its ength was governed by the distance between the centres of my lathe. People who have longer lathes could, with advantage, make the column 3 in. longer. This ground bar was truly centred, then turned between centres to fit the baseplate (press fit) and the headstock (light press fit).

At this point the squareness of the column with the base table was carefully checked and found to be correct to within 0.0005 in. in total length.

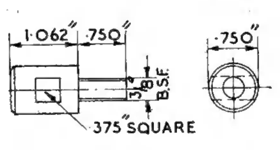
The sleeve for the spindle was my next big job. This was held in the four-jaw chuck and the three-point steady, and was bored and reamed to 1.000 in. dia. and then counter-bored to receive the thrust-bearing Hoffmann W¾. Care should be taken when making this counter-bore. The back of the hole is a light press fit for one ring of the thrust-race, but the front of the hole is opened out until it is about 0.005 in. clearance on the second ring of the ball-bearing. In other words, one half of the bearing remains stationary, and the other half is free to revolve with the spindle, but the amount of clearance is small enough to retain the grease with which the bearing is filled before assembly. The sleeve was then pressed upon a mandrel and turned to fit the headstock casting



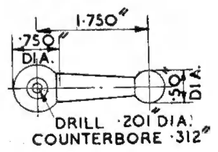
Detail 3—1 *off, cast-iron*



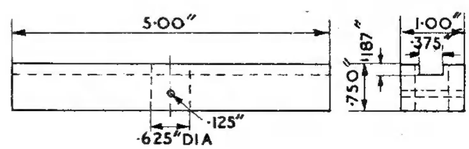
Detail 20—1 *off, mild-steel*



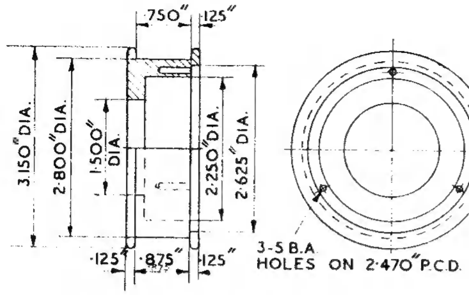
Detail 44—2 *off, mild-steel*



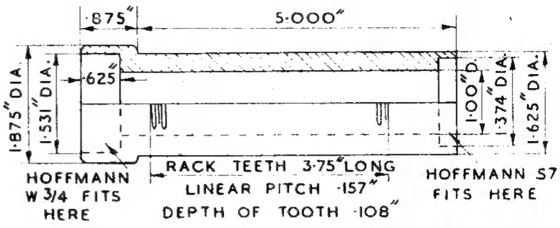
Detail 47—1 *off, mild-steel*



Detail 19—1 *off, mild-steel*

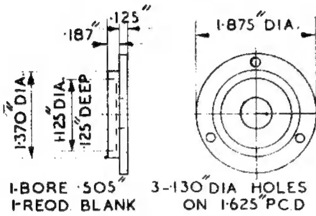


Detail 21—2 *off, mild-steel or cast-iron*

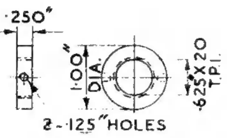


Detail 4—1 *off, mild-steel*

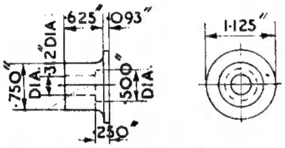
Detail 19*A*—1 *off, mild-steel*



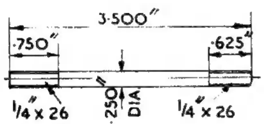
Detail 29—2 *off, brass*



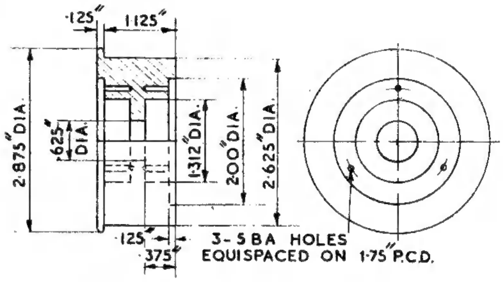
Detail 9—2 *off, mild-steel*



Detail 42—1 *off, mild-steel*



Detail 40—4 *off, mild-steel*



Detail 33—1 *off, mild-steel or cast-iron*

(sliding fit). It was then taken off the mandrel and set up in the four-jaw chuck and three-point steady again and counterbored at the other end to receive the ball-bearing Hoffmann S7 (light press fit). In order to satisfy myself that the three holes were concentric with each other, I then put the sleeve back upon the mandrel and checked the two counterbores with the internal attachment of the dial indicator.

The rack was cut by holding the sleeve in a machine vice mounted upon the boring table of the vertical slide, and by running a 20 d.p. cutter on an arbor between the centres of the lathe. Spacing was achieved by a large micrometer handle which replaces the gear on the end of the leadscrew. This micrometer dial is 5 in. in diameter and in practice it is very easy to space with it to 0.0005 in. Now the teeth of a rack are of the same proportions as the teeth of the pinion or gear which meshes with it. The pitch of the rack is found, therefore, by dividing 3.1416 in. by the diametral pitch. In this case it is $\frac{3.1146}{20} = 0.157$ in. Extreme care has to be taken to see that this figure is maintained at every division and that the screw is always turned *in the same direction* : overwinding and back turning will only result in inaccuracy, and a rack which has thick and thin teeth—with correspondingly disastrous results when using 0.025 in. dia. drills.

The spindle was the next ticklish job. Its length and slenderness made it impossible for turning without a travelling steady, and as no such item had been included in the equipment of the lathe, it now became necessary to make one. It was designed to straddle the boring table, leaving the compound slides of the machine completely unrestricted in their movements. Once the steady was fitted, the job became easy. It was as a matter of fact a real pleasure to watch the tool and steady in action—the results being comparable to those usually associated with a well set roller-box on a good capstan. The keyway was cut in the spindle by holding a Woodruffe cutter in the three-jaw chuck ; the spindle being clamped in a long vee-block securely bolted to the boring table of the vertical-slide.

The countershaft ball-race housings were made from two pieces of mild-steel, but these would have been equally suitable in cast-iron ; in fact, it would be easier to make a pattern to the correct shape and cast two off. The housings were bored in the four-jaw chuck to receive the bearings, Hoffman LS7 (light press fit). Cover plates are fitted and these were made of brass, but could be made in either steel or aluminium. They carry no load and are intended only to retain grease and exclude dirt.

The cone pulleys are turned all over, inside and out. It will be noticed that the photograph of the patterns does not include the patterns for these ; they were still at the foundry when the camera was used. They are perfectly straightforward patterns, being exactly to the drawings plus an allowance on all dimensions for turning. These cone pulleys were balanced after the keyway and grub-screw holes had been cut and drilled. They were given a coat of cellulose enamel inside to preserve them from the almost inevitable rusting from condensation.

(*To be continued*)

A WATER-GAUGE FOR MODEL BOILERS

By K. N. Harris

OCCASIONALLY in the past, there has been some criticism of the principle of "end-holding" as applied to the glasses of model water-gauges. The principle was successfully introduced into full-size practice about 50 years ago, whilst several colleagues and myself have, over a number of years, used it on many occasions for model work with complete success. Nevertheless, since there are a number of people who accept criticisms of this nature, I cast about in my mind for a design which, whilst retaining the undoubted advantages of unit construction, could be made without having to embody the end-holding principle.

Unit construction ensures two most important things :

(1) If properly constructed in the first place, there is no possibility of misalignment between top and bottom fittings, for they are a unit.

(2) The glass, situated as it is, is almost perfectly protected from anything but deliberate sabotage, whilst at the same time good visibility is maintained.

The drawing shows full details of a gauge I have made on this principle for a model locomotive. No dimensions are given, as these can obviously be adapted to suit any case ; the actual gauge shown uses a $\frac{3}{16}$-in. glass and is a bare $3\frac{1}{2}$ in. from top of top plug to bottom of nut on draincock spindle, whilst the body is 13/32 in. sq. The whole job is built-up and silver-soldered, as this makes a much neater and cleaner job than would a casting. A simple jig was made for drilling the flanges, and can be applied to the corresponding seatings.

The vision slots through the body were end-milled out, the side slots being somewhat narrower than the fore and aft slots, actually 7/32 in. and 9/32 in. ; but if milling is not convenient, they can be dealt with quite simply by drilling and filing.

The position of the blow-down valve is unusual and makes a much neater job than sticking one on at right-angles and having it stand half way across the footplate. The wheel of the valve is fibre, knurled on its edge. Photograph No. 1 shows the gauge as a plain job, whilst Photograph No. 2 shows it with a three-sided "Perspex" protector on it, held in place by two light strip-brass clips, which themselves are closed by two screws and nuts at the back of the gauge body. This protector is rather like gilding the lily, but it is easy to make, and in no way interferes with visibility.

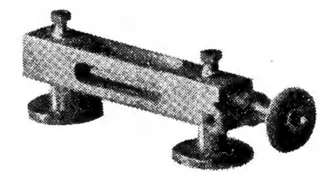
The design has been criticised for embodying shut-off cocks, on the ground that these were unnecessary in small sizes. I am cognisant of this fact.

Some people may consider that, in the new design, the replacement of a glass is more difficult than with a normal type of gauge, and that it involves the removal of both top plug and drain valve. The latter is quite true ; but, by the aid of the simple gadgets shown in Fig. 2, the job can be done in about 30 sec. The alternative is to use the principle of "end-holding" the glass !

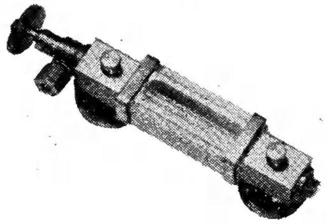
The procedure for fitting a glass is as follows: (1) Slip rubber ring over one end of glass, allowing glass just to stand through. (2) Insert glass through bottom fitting of gauge and screw in ferrule with special tubular key. (3) Place second rubber ring on end of special mandrel (wet end of mandrel) and slip pusher sleeve on behind it. (4) Insert assembly into top of gauge with end of mandrel resting on end of glass and push rubber ring over glass with pusher sleeve. (5) Insert ferrule and screw up.

NOTE.—(*a*) Ferrules need only be screwed up finger tight. (*b*) The end of the mandrel should be slightly rounded and its diameter should be a thou. or two larger than that of the glass tube. (*d*) The pusher sleeve should be an easy fit on the mandrel.

Points to note in the gauge construction are that the glass should be a free fit in the body and the ferrules should be a free fit round the glass, and screw easily into place; when screwed home, their outer edges must, of course, clear the steam and water passages. The rubber rings should be cut from surgical rubber tubing, which will stand high temperatures without losing its nature.



No. 1



No. 2

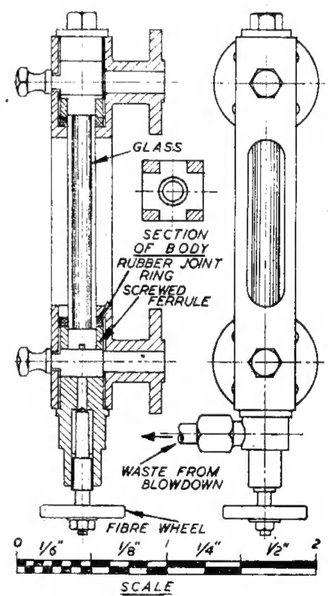


Fig. 1

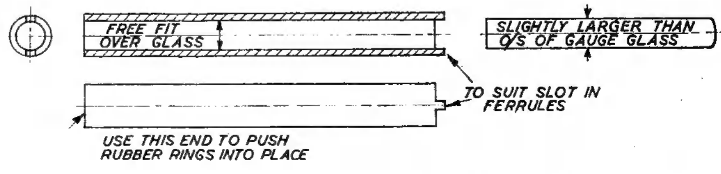


Fig. 2. *Detail of assembly tools*

L.B.S.C.'s "Britannia" in 3½ in. Gauge

● A NEW YEAR MESSAGE ● CONSTRUCTION OF THE SUPERHEATER COMPONENTS

THIS being the first issue of this journal in the New Year, I would like to take the opportunity of wishing all followers of the Live Steam notes, whoever they are and wherever they may be, good health, good luck, happiness and prosperity during 1953 and onwards. Looking back over the past year, it has been an uneventful one for your humble servant. In these notes, I have done my best to keep up interest, and put a little jam and sugar around the pills of instruction, and have been very gratified by the correspondence received, with news and pictures of locomotives built to "words and music," that have exceeded minimum "guaranteed" performance. The number of *Tich* and *Juliet* engines that have been built, must be an all-time record; proof of the fact that an easily-built and quickly-described engine remains a prime favourite. As to my own work, writing, drawing, and answering correspondence, takes such a time nowadays, that I get little chance of doing much for myself; my own *Britannia* is very much behind schedule, and I have made little progress on the two experimental jobs in hand. My fleet of running locomotives naturally need an occasional "shed day," same as their big sisters; and as I am also the permanent-way gang on my little railway, besides being signal-maintainer and electrician, I don't get much chance of going to sleep on the job! However, I just "keep on keeping on," and am thankful that nature gives me health and strength to do it, sympathising with those who are not so fortunate.

Nothing startling seems to have happened in full-size practice during the past year, except, perhaps, the amazing performances put up by the *Britannias* on the old Great Eastern line, where most of the enginemen are unprejudiced and know a good thing when they see it. The Southern spam-cans still hold the record for coal-eating! As to happenings in the world at large, the less said the better; personally, I think it would have been a benefit to mankind if the hydrogen bomb, when it exploded, had wiped out everything and everybody connected with bloodshed and destruction. 'Nuff sed—let's get on with the doings; and before I forget it, there is just one thing to mention. For those builders who would prefer a slide-valve regulator instead of the poppet-valve type, I propose describing a suitable one, as alternative, in the next instalment of this serial; but it will be so arranged, that the superheater described below, will be suitable for either type.

Superheater elements

Both side and end views of the superheater were given along with the drawings of the poppet-valve regulator, and all necessary dimensions were included. There are four elements, with block-type return bends. Each upper element requires a piece of ¼ in. × 22 gauge copper tube approximately 11⅜ in. long; and the lower ones need similar pieces, ½ in. longer. Each return bend is made from a block of copper of ⅝ in. × ⅜ in. section, and ⅝ in. long; maybe our advertisers who supply castings for the engine, could "come to the aid of the party" with castings of proper shape, but they would need to be in some metal that will stand brazing heat, such as that used for plumbers' weldable fittings. Silver-soldering isn't good enough for joints at the firebox end of a superheater; not on Curly engines, anyway! On the centre line of one end, make two centre-pops 5/16 in. apart, and drill in on the slant, so that the holes break into each other just inside the block; use letter C drill if you have it, but if not, ¼ in. will have to do. Fit one long and one short element into each, and braze the joints. Just anoint with Boron compo mixed to a paste with water, or powdered borax served likewise, blow to bright red, and touch the joints with a bit of soft brass wire. Sifbronze, and the special flux sold with it, is the cat's whiskers for this kind of job, as it leaves a lovely fillet all around the pipes. Pickle and wash off, then file the outside of the blocks to the shape shown.

Headers and flange

Both the hot and wet headers are made from 3½ in. lengths of ⅜-in. copper tube, 22 gauge; or a little thicker would do. If you have any odd bits of 7/16-in. tube, they could be used instead of ⅜-in., as the exact diameter doesn't matter. Square off the ends in the lathe, and plug them either with discs of 1/16-in. sheet copper, or slices parted off a bronze bar turned to a drive fit. The ends of the bits of tube should be slightly countersunk, which forms a channel for the silver-solder (this is O.K. at the smokebox end). Each header tube has four holes drilled in it, for the elements, at the same spacing as the superheater flues, using letter C or ¼-in. drill. In addition, the wet header has two similar-sized holes at ⅜ in. centres, for the vertical steam pipes; you'll see the exact place at which to drill these, by looking at the drawings referred to previously. At approximately ⅝ in. away, drill a No. 32 hole for the air pipe from the snifting-valve, which we are using in place of an anti-carboniser. When drilling the hot header, put the drill clean through the pipe at the two end holes, as the steam pipes are fitted right opposite the end elements.

The flange, for attaching the superheater to the regulator body, may either be a gunmetal casting, or cut from a block of brass; it is ⅞ in. square and ⅜ in. thick. Face one side truly, either in four-jaw, or else by the method described for port faces, and drill a blind hole ⅜ in. diameter in the middle. In one of the edges, drill two letter C or ¼ in. holes at ⅜ in. centres, breaking into the blind hole; also drill four No. 34 screwholes in the corners, which may be rounded off as shown.

The steam pipes between the hot header and the smokebox unions, are pieces of ¼-in. copper tube (same as elements) approximately 6 in. long, one end of each being furnished with a ⅜-in. × 26 union nut and cone. The union nuts are made from ½-in. hexagon rod, and the cones from copper rod or tube, an easy fit in the nuts. I've explained so many times, how to make union nuts and cones, that repetition is hardly necessary here; suffice it to say that the angle of the cone can be turned either by slewing the top slide around, and setting the tool to the angle of a Slocomb or similar centre drill held in the chuck, or

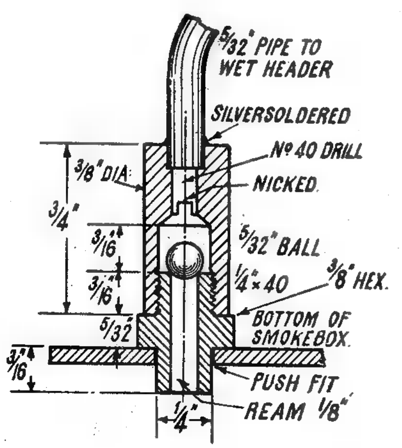
grinding off the corner of a square-nosed tool, and setting it to the same angle. Naturally, somebody *would* be perverse, and say why not set it to the angle of the lathe centre-point; but though the latter is, in theory, ground to the same angle as a centre-drill in practice it may *not* be (I've met some defaulters myself!) and as you countersink the female part of the union with a centre-drill, you can't go wrong in setting your coning tool to the same angle! Incidentally, a degree or so on the obtuse side ensures a tight union, as the nut crushes the cone into a perfect seating in the socket, the copper being soft on account of the silver-soldering heat.

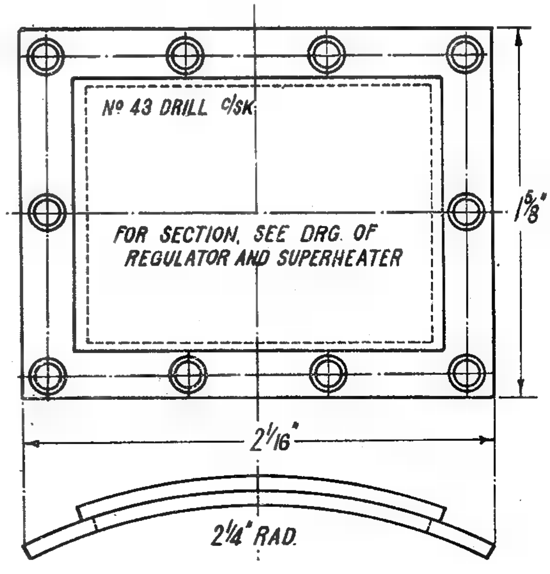
How to assemble the superheater

The ends of the elements should be just roughed up with a file until they are a very tight fit in the holes in the headers, into which they are fitted, as shown in the last instalment. The plain ends of the steam pipes are given a dose of the same medicine and fitted into the two front holes in the hot header; let them stay straight, for the time being. Two $\frac{3}{4}$-in. lengths of $\frac{1}{4}$-in. copper tube are needed, to connect the flange to the wet header; rough up, then squeeze them into the side holes in the flange, putting the other ends into the holes in the top of the wet header. A piece of 5/32-in. copper pipe about 6 in. long is fitted to the small hole in the wet header.

Now anoint every joint in the whole bag of tricks, either with a paste made from powdered borax and water, or Easyflo flux and water. Put the assembly in your brazing pan, heat to dull red—flange, headers, and element and steam pipe ends—and apply a strip of best grade silver-solder, or Easyflo. If an extra-strong job is needed, use Johnson-Matthey's B6 alloy; it needs very little more heat. It works all right with borax as flux, or Johnson-Matthey's "Tenacity No. 1" can be used; this gives a cleaner job, as the burnt flux can easily be removed. It isn't as "glassy" as borax. Tell it not in Killiecrankie, but B6 dinna cost sae mony bawbees as Easyflo—vot you tink, eh? Don't forget to do the plugs at the ends of the header tubes. Let the assembly cool to black; and after a short spell in the pickle bath, give it a jolly good wash under the kitchen tap, letting the water run through, to clean every bit of scale and grit from inside the pipes. If you can arrange to squirt some water through under pressure, do so. At our hacienda, we get 80 lb. pressure at times on the main (once, when washing my gasoline buggy, I inadvertently screwed the spray nozzle down too tightly, and the three-ply canvas-rubber hose burst) and with a suitable adapter and nozzle, I don't have any trouble in getting scale, etc., out of brazed pipes, or cleaning the inside of a boiler under construction.

The erection is a very simple job. At $1\frac{1}{8}$ in. below the centre-line of the smokebox, and in line with the centre of the chimney, drill a $\frac{3}{8}$-in. hole at each side. Slide the elements into the flues, until the square flange butts up against the regulator body. See that the holes in regulator body and flange line up all right, then temporarily clamp the flange in position and run the No. 34 drill through the screwholes, making countersinks in the body; remove flange, drill countersinks No. 44, tap 6 B.A., and smooth off any burring. Replace flange with a 1/64-in. Hallite or similar gasket between the contact faces, and secure with four 6-B.A. screws. Cheesehead screws are best for jobs inside the smokebox; you can get at them easily with a screwdriver, if occasion should arise, whereas a spanner—even a long box spanner—is troublesome to operate. Bend the steam pipes as shown in the drawings given with the last instalment. By crossing them as shown, both bending and coupling-up are rendered far more easy than if the pipes were taken direct to the unions on the same side. Put the smokebox temporarily in place, and line up the union nuts with the holes, as shown in the illustrations mentioned above; then you'll be all ready to couple up when the boiler is erected, and the outside steam pipes are in place. Bend the snifting-valve pipe into a big swan neck, so that the free end





Section of the snifting-valve

Right—Smokebox inspection cover

comes down near the front of the smokebox.

Inspection cover

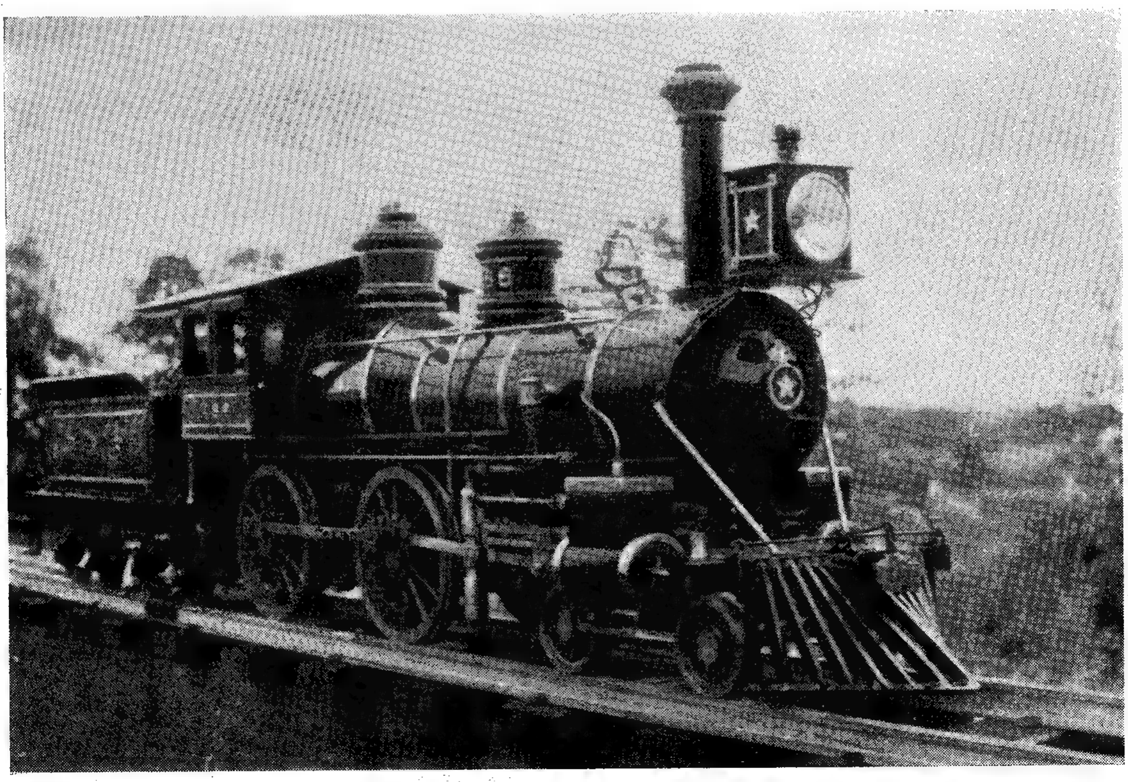
The big hole over the regulator block may be closed by a cast cover, or one may be built up from sheet metal. The flange of a cast cover can be bedded to the curve of the smokebox, by rubbing it on a sheet of emery-cloth, or similar abrasive, laid on the smokebox barrel, or a piece of tube the same diameter; and Inspector Meticulous won't be able to raise any moan about the slight difference between radii of flange and smokebox, in this case, because a gasket of 1/64-in. Hallite, or similar jointing, will be needed between the contact faces, and that will make up for the thickness of the emery-cloth! The flange should, of course, be smoothed with a file before bedding it down, if there are any superfluous knobs and excrescences on it. The outside of the casting can also be titivated up with the same humble but indispensable tool.

To fabricate the cover (that sounds very posh!) cut out a piece of 16-gauge sheet brass or copper—steel will do, at a pinch—$2\frac{1}{8}$ in. long and $1\frac{5}{8}$ in. wide. Cut a hole in this, measuring $1\frac{1}{8}$ in. × $1\frac{1}{2}$ in., and bend it to the radius of the smokebox barrel. Now cut another piece of similar metal $1\frac{3}{16}$ in. × $1\frac{3}{4}$ in., that will just cover the hole nicely, with a wee bit of overlap. Bend this to the radius of the convex side of the flange; if brass or copper silver-solder it, and if steel, braze it in position; you don't need details for that simple job! Either the cast or built-up cover can be attached to the smokebox shell in the same way. Drill ten No. 43 holes in the flange, in the position shown in the plan view, countersink them, put the cover in place over the hole in the smokebox, and use the holes as a guide for drilling and tapping the screwholes in the smokebox barrel. Use No. 51 drill, tap 8 B.A., and attach the cover with 8-B.A. countersunk screws, putting a joint gasket between flange and smokebox, as mentioned above. Tip—if the smokebox barrel is made from steel, or if the cover is ditto, use brass screws. The cover need not be permanently attached until the boiler is erected.

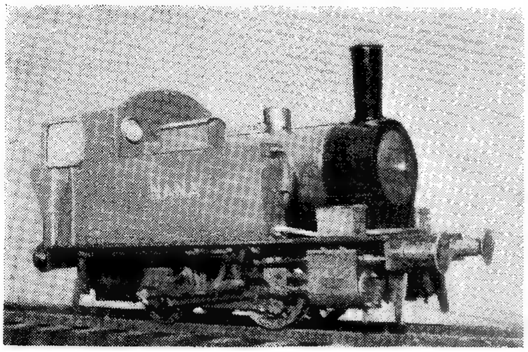
The cover for the dome bush is made and fitted exactly the same as the front cylinder covers, so there is no need for repetition. It is $1\frac{7}{8}$ in. diameter, has a 1/32-in. register or spigot an easy fit in the dome bush; it is attached by 12 6-B.A. brass countersunk screws, and has a 1/64-in. Hallite or similar gasket between the contact faces.

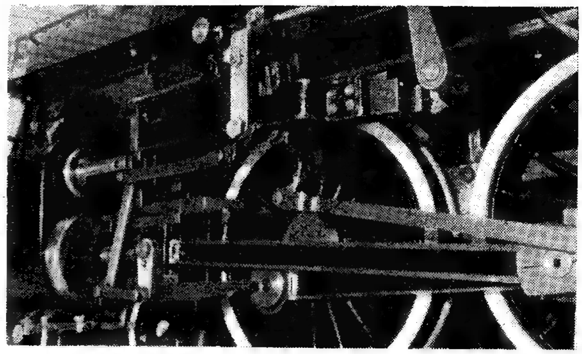
Snifting-valve

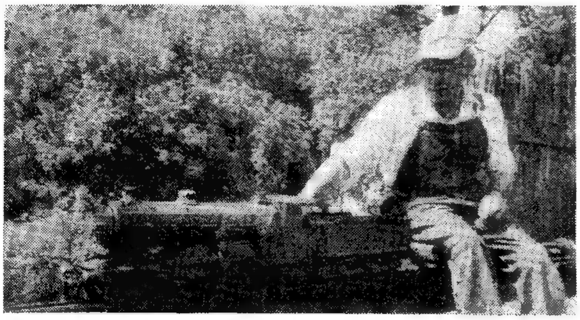
The snifting-valve is simply an ordinary check valve or clack, made from $\frac{3}{8}$-in. bronze or gunmetal rod, to the dimensions given in the accompanying sketch. The top part of it is silver-soldered to the 5/32-in. pipe coming from the wet header of the superheater, and the spigot on the ball seating is pushed through a $\frac{1}{4}$-in. hole, which can be drilled at any point you fancy, at the bottom of the smokebox. Just ahead of the blast pipe is as good a place as any; I usually put mine there. When the engine is coasting, the suction in the cylinders lifts the ball off the seating and allows air to enter and destroy the vacuum. No ashes nor grit can be sucked down the blastpipe, and the cylinders are not cooled, as the



"Those were the days," says Mr. Morewood's old-timer







Top left—A variation of " Juliet " by Al Rothermal—a first cousin to the " Chingford Express "

Above—Bill Van Brocklin's Atlantic jumper—the works. Puzzle—how big is the locomotive ?

Left—Ed. Leaver pulls one on his " Maisie "

air has to pass through the superheater; this also prevents any overheating and burning of the elements. It would, of course, be possible to add a drifting-valve to the regulator, allowing a little steam to pass, and destroying the vacuum that way; but the air snifter is simpler, and in your humble servant's opinion, more effective. All my own engines have them, and they coast very freely. Next stage, alternative regulator, and boiler fittings.

Picture gallery

I usually like to put in a few pictures of what " the boys " are doing, when a New Year is ushered in, so here are some selected from a big batch kindly forwarded by Billy Van Brocklin, of Roslindale, Mass., U.S.A. One shows a *Maisie* very far away from the Kings' Cross-York run. Her builder, seen driving, is Ed. Leaver, retired engineer of the New York, New Haven and Hartford R.R., formerly of the old S.E. & C.R. By the way, who was it said " there's nothing in a name? " Bro. Ed., and one of my correspondents who is a fireman and rejoices in the name of Cole, would have made a very appropriately-named engine-crew ! Mr. Morewood's old-time 4-4-0 is certainly a very realistic bit of goods, and a credit to her builder. *Nana* is a partly Americanised version of *Juliet*, with Southern valve-gear, built by Al Rothermal, and is practically another edition of Carl Purinton's *Granny*. Despite the transatlantic cylinders and motion, and having only four wheels, there is a distinct atmosphere of the Liverpool Street-Chingford line about her, although she has never been within three thousand miles of it.

Finally, we have a photograph that might have been taken from a full-sized engine, showing the " works " of Bill Van Brocklin's 4-4-2 *Juniper*. She is only a $3\frac{1}{2}$-in. gauge job, but has all she needs ; note the cylinder drains, valve spindle guides, and Baker reverse yoke cut from the solid.

Catalogues Received

Bassett-Lowke Ltd. have sent us copies of their latest catalogues, one for Gauge " O " model railways, and the other for model shipping and engineering. The former consists of 40 pages in which equipment and rolling stock of all kinds for Gauge " O " are listed and illustrated.

We note that some new products are included, chief among them being Southern Region electric main-line motor coaches and trailers which are nicely representative of their prototypes ; there is a new type of station based on contemporary style of concrete construction and of simple, pleasing design. The freight stock section shows a new and up-to-date brake-van and a new cattle wagon, both very realistic in general appearance.

The cover design of this catalogue is printed in colours from an original painting by Mr. E. W. Twining ; it is a typical view as seen by a signalman on duty and might be located almost anywhere on British Railways, except the Western Region. The price of this catalogue is 1s.

The " Model Shipping and Engineering " catalogue consists of 96 pages, and is quite new in format, compared with previous catalogues of this kind. Into it have been brought all items that were previously listed separately in two price lists, a considerable number of new parts including boiler and ships' fittings, engine castings, gears, screws and screwing tackle, as well as a very extensive and enlarged selection of plans and drawings for models of all kinds. The price of this catalogue is 2s.

In the Workshop . . . .

STOVE-ENAMELLING

by DUPLEX

MOST amateurs and many commercial workshops seem to fight shy of using a stove-enamelled finish for metal parts. The reason for this is not very clear, except that there seems to be some reluctance to embark on a venture that is regarded as fraught with difficulties and uncertain in its results.

It is true to say, however, that stove-enamelling is not a difficult process, and a satisfactory finish can be obtained with certainty if ordinary care is taken. Moreover, no elaborate equipment is needed where the work is carried out on a small scale. The resulting surface is oil-proof, and will withstand hard usage better than an air-drying, painted finish. For this reason, and because the operation takes only some one and a half hours to complete, stove enamelling is largely used in industry when the rapid production of a durable finish is essential.

The process consists in first covering the work with an even coating of enamel specially prepared for the purpose; then, after the parts have been allowed to dry in the air for a few minutes, the work is transferred to a heated oven for hardening the paint.

The stoving temperature and the period of heating required are both specified by the manufacturer of the enamel, and should be strictly observed to obtain the best results. However, a slight increase of the recommended temperature may have no ill effect where black or dark shades are used, but light-tinted enamel may be discoloured.

The Stove-Enamelling Oven

Enamelling on a small scale can quite well be carried out in an ordinary gas or electric cooking stove, as long as the internal temperature is recorded by a thermometer and can be properly controlled. Domestic arrangements will, however, be less liable to be upset if the stove-enamelling plant is installed in the workshop, and the arrangement illustrated in Fig. 1 may serve as a guide. The oven shown in the photograph is a Belling 600 W cooker, and was picked up for a few shillings at an auction sale. The interior fittings, shown in Fig. 2, consist of a rack and a tray, both of which are removable; the rack is useful for suspending the work, and the tray will catch any paint drippings where the enamel has been applied too thickly. When the photograph, Fig. 1, was taken, the variable resistance, seen on the left of the illustration, was employed for regulating the temperature. Later, however, this rheostat was replaced by a "Sunvic" control.

The "Sunvic" instrument will, no doubt, be familiar to many readers, as it is largely used for controlling domestic heating appliances; no electrical energy is dissipated except that needed to operate the small, built-in thermostat, whereas the old-fashioned, sliding resistance is very wasteful of current. As shown in Fig. 3, the oven door is fitted with a thermometer for registering the internal temperature.

By hanging small objects from the rack and standing larger components on the tray, the heated air can freely reach all parts of the work and maintain it at a uniform temperature. As the floor space provided in this way measures 11 in. × 17 in., the oven is capable of dealing with a large variety of work. It should, perhaps, be explained that the type of oven described is that known as a convection oven, in which the transference of heat from the walls of the oven to the work is effected by the circulating, hot air. Although this kind of oven is still much used industrially, the large work that is now commonly finished by stove-enamelling requires an oven greatly differing in construction from the simple equipment under consideration.

Stoving Enamels

Most paint manufacturers market stoving enamels, but the difficulty may be to obtain supplies in the small quantities required for only occasional use. There are several kinds of enamels for giving different finishes to the work, but those commonly used form either a glossy, a matt, or a wrinkled surface. There is, too, a wide range of colours available.

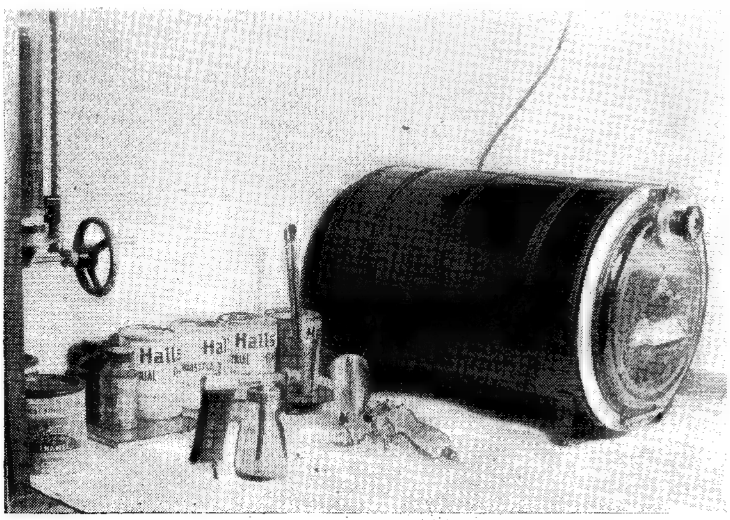
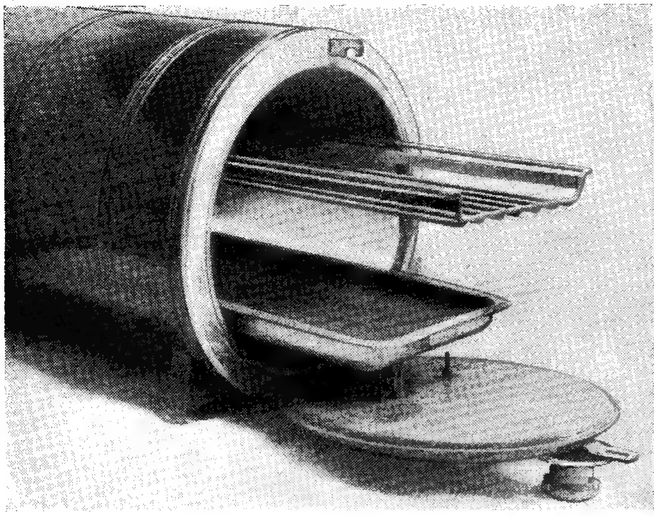
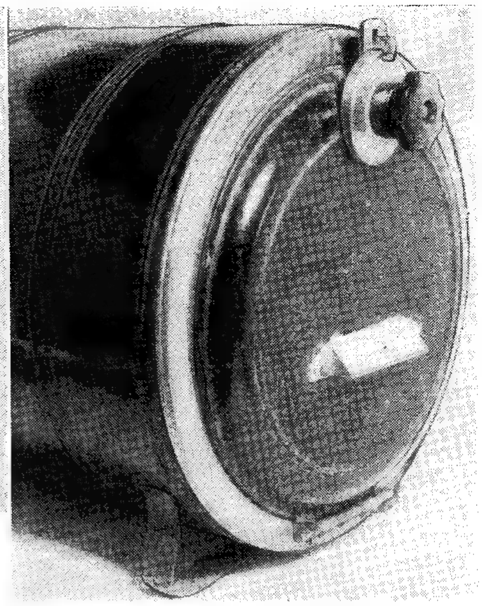


Fig. 1. The workshop stove-enamelling equipment





Above—Fig. 2. The rack and tray within the oven

Right—Fig. 3. The oven door fitted with a thermometer

Preparing the Work

Rough castings should first be filed to remove irregularities and, where necessary, a filler or stopper should be applied and afterwards rubbed down in order to obtain a smooth surface. If the work is to be finished with a matt or wrinkle enamel, any roughness of the surface may not show up; but with a glossy finish a smooth underlying surface is essential.

In addition, any blow-holes in a casting should be opened up or filled with stopping material, for if this is not done, the trapped air will expand during stoving and will cause a blister to form on the surface.

Filing the work will provide a good key for the enamel, but a thorough wire-brushing will usually be sufficient. All grease must be removed with a rag dipped in either petrol or carbon tetrachloride; however, when the latter fluid is used, it is best to work in the open air, as inhaling the vapour may be injurious.

Work previously painted should be cleaned with a paint stripper and then well wire-brushed. All rust must be removed with the wire brush and emery cloth, and the dust formed should be cleaned off before the surface is finally degreased.

Before applying the enamel, it is advisable to stop any machined holes in the work with well-fitting pins or screws, for clearing hard enamel from the holes may, later on, waste much time; these plugs are removed before the work is stoved.

Methods of Applying the Enamel

There are three methods in common use for covering the work with an even coating of enamel before stoving. These are: hand-painting, dipping, and spraying.

Hand-painting is suitable for light-bodied enamels, but will not be found satisfactory for applying those of heavier consistency. Dipping is a process largely used in industry and consists in suspending the work on a wire hook and then immersing it in the enamel. After being withdrawn, the parts are hung up to allow the surplus paint to drain back into the main tank.

As it is essential that the coating should be even throughout, it is important to make sure that the enamel does not accumulate in the recesses or at the corners of the work. This is best avoided by suspending the work with an angle or edge at the lowest point, so that the paint will run downwards and collect where it can be wiped off most easily. For this purpose, a small brush is used in the way shown in Fig. 4, and if the brush is first wetted with paint solvent, the surplus enamel will be more readily removed. During the preliminary period of air-drying, this treatment may have to be repeated several times, for once the work has been placed in the heated oven, no further correction of surface blemishes will be possible.

Spraying on the Enamel

A good finish on the work is much more easily obtained if the enamel is applied with a spray-gun.

In the issue of this journal of January 11th, 1951, and in the following numbers, details were given of a modified "Model Engineer" paint gun, and a gravity-feed gun was also described. Both of these guns are suitable for the present purpose. The "Model Engineer" gun will spray the lighter-bodied enamels, but the gravity gun is better for applying paints of thicker consistency.

There is no need to go into details about the air supply, as this has been fully dealt with by several contributors in the past.

It should, however, be pointed out that a pressure of 90 lb. per sq. in. is needed to atomise some enamels, and the volume and pressure of the air supply must, therefore, be arranged accordingly.

General instructions for using the spray-gun were given in an article on the subject, dated February 8th, 1951, but it may be as well to emphasise certain points. The enamel should be sprayed on in several thin coats and intervals allowed for air-drying; this will avoid the formation of runs that are so liable to form when a single, thick application is made. At the same time, any excess of paint in one place can readily be removed in the way previously described.

As thin enamel can be atomised by air pressure ranging from 20 to 40 p.s.i., there would seem to be some advantage in using well-

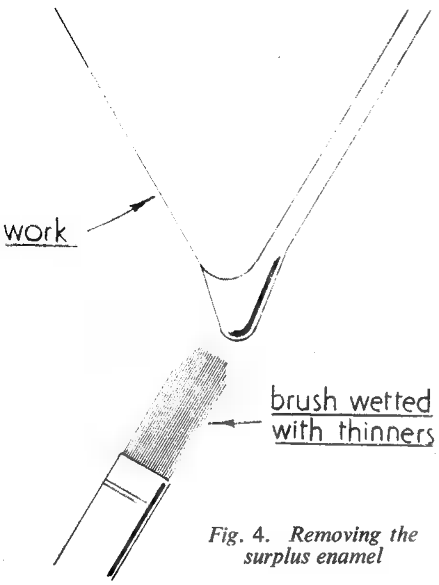


Fig. 4. Removing the surplus enamel

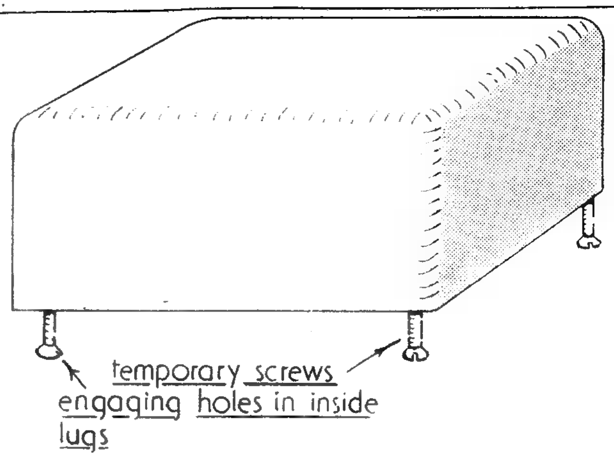


Fig. 5. Method of supporting the work for spraying

diluted paint. But, here, the manufacturers' instructions should be closely followed, as some enamels must be used in the condition received, and not diluted in any way. Where dilution is permissible, it is essential to employ the right thinning agent.

Supporting the Work

To enable the work to be sprayed without being handled, it can be hung on a length of string by means of ■ hook, or the string can be fastened to a screw or bolt fixed to the work. A more convenient method is to support the work on a light turn-table of the kind described in the articles previously referred to. However, the work-piece can often be fitted with temporary screws to serve as feet, and the work will then stand on these in the oven tray to save any further handling during stoving; an example of this is shown in Fig. 5, but if the component is hollow, an internal supporting block can be used instead.

Wrinkle ■ Crackle Finish

This finish is, perhaps, best confined to instruments and kindred classes of work, for many regard it as objectionable on machine tools, where it is very difficult to clean once the surface has become oily or is exposed to chips. A wrinkle finish is obtained by using a special kind of enamel that takes up this surface pattern during the stoving process.

The enamel giving ■ coarse pattern dries with a glossy finish, but that forming a finer wrinkled pattern has either a semi-gloss or a matt appearance after stoving.

No difficulty will be found in obtaining good results if the manufacturers' instructions are closely followed, but it is important to use the enamel in ■ fresh state as, after being kept for six months or so, the enamel may not give a satisfactory wrinkled finish. If there is any doubt in the matter, a trial should be made on a piece of sheet metal.

The enamel is made for spray application only and is of rather thick consistency, so that an air pressure of from 60 to 90 p.s.i. is needed for proper atomisation.

A thick coating should be built up on the work by making several applications with the spray-gun. After spraying, the work is allowed to dry in the air for a few minutes. At a temperature of 250 deg. F., stoving usually occupies an hour, but this period is increased to $1\frac{1}{2}$ or 2 hours for large and heavy work.

After stoving, the work must be left until it is quite cold before being handled, for while still hot the enamel remains soft and the surface is easily damaged.

RAWLPLUG "DURIUM" DRILLS

We have recently tested one of the Durium-tipped spiral fluted drills manufactured by the Rawlplug Co. Ltd., Cromwell Road, London, S.W.7, for rotary drilling of specially hard materials, such as stone, cement, slate, tiles, etc. These drills are made in two ranges, from 6 to 30 for Rawlplugs, and C to G for Rawlbolts. They consist of a spiral fluted steel shank tipped with Durium cemented carbide, and can be used either in an electric drill or a hand drill brace. The latter was employed in our tests, and the drill was found to cut rapidly in the hardest materials, producing ■ clean hole and avoiding the objectionable tendency to break through at the back often encountered with percussion drills. Owing to the hard and tough tip, the cutting edge is very durable, but when it becomes blunted the drill may be returned to the makers for re-sharpening; it should be noted that this cannot be done on an ordinary grinding wheel.

The makers claim that the Durium drill overcomes the painstaking, laborious and even frightening process of boring holes in masonry with the hand percussion tool, in that the drill, even when used in ■ hand-brace entirely eliminates all the terrors.

Durium drills, in common with other Rawlplug products, are obtainable at ironmongers and tool dealers.

QUERIES and REPLIES

"THE M.E." FREE ADVICE SERVICE. Queries from readers [redacted] matters connected with model engineering are replied to by post as promptly as possible. If considered of general interest the query and reply may also be published on this page. The following rules must, however, be complied with:

(1) Queries must be of a practical nature on subjects within the scope of this journal.
(2) Only queries which admit of a reasonably brief reply can be dealt with.
(3) Queries should not be sent under the same cover as any other communication.
(4) Queries involving the buying, selling, or valuation of models or equipment, or hypothetical queries such as examination questions, cannot be answered.
(5) A stamped addressed envelope must accompany each query.
(6) Envelopes must be marked "Query" and be addressed to THE MODEL ENGINEER, 19-20 Noel Street, London, W.1.

"Kiwi" Carburettor

Will you please explain the purpose of the $\frac{1}{16}$ in. hole in the jet housing of the "Kiwi" carburettor, as shown on the drawing. I have an engine fitted with this carburettor, and cannot get it to run evenly. I found on inspection that this hole had not been drilled.

J.E.B. (Nantwich).

The object of the $\frac{1}{16}$ in. hole drilled from the outside of the castings into the jet housing is to admit air to the small annular passage around the jet. This passage serves as a small primary choke tube to keep up the air velocity at the tip of the jet at low speeds. It is essential that the hole should emerge into the plain part above the thread of the jet housing. In other respects, its position is not highly important. We would, however, emphasise that the tip of the jet tube should lie practically flush with the hole of the main choke tube to get correct compensation. If too high, the mixture will be weakened at low speeds, and if too low, the reverse will apply.

Lathe Headstock Bearings

I am constructing a $4\frac{1}{2}$-in. centre lathe for model engineering work from castings which I have purchased, and I would be grateful to have your advice as to the most suitable type of bearings for the headstock mandrel. I propose to use three-speed driving pulleys with back gearing, and a mandrel with No. 2 morse taper, and provision for driving a train of screwcutting gears from the tail end of the mandrel. I should also like some advice on the best material to be used for the mandrel bearings.

J.R. (East Farleigh).

The success of the lathe headstock bearing depends far more on details of design and accuracy of workmanship than in the adoption of any particular type or principle of bearing. Almost every type of bearing has been used with a reasonable measure of success in lathe headstocks, and the success of any of the more advanced designs can only be obtained when they are machined and fitted to a very high degree of precision.

In the case of tapered roller-bearings, which have been used with great success on some of the more expensive lathes, it is necessary to use bearings machined to special limits of accuracy, and both the housings and the mandrel seating, also the adjustment of the bearing, must be beyond reproach. Our own choice for a home-made lathe would be to use a plain parallel-bearing fitted as accurately as possible, and with some means of adjustment, though this is only likely to require taking up at very infrequent intervals.

Any good quality steel can be used successfully for a lathe mandrel, but a high tensile steel, or one hardened and ground after machining, will give better results. Generally speaking, the harder the material for the bearing, the longer life is obtained before readjustment, but bearing materials such as bronze or a suitable type of white metal have also been used with great success.

Fitting up a Bench Lathe

I have obtained a second-hand $3\frac{1}{2}$-in. screwcutting lathe, and propose to mount it on a sturdy wooden bench, with the back legs extended upwards to act as supports for the countershaft. Will this arrangement be satisfactory? As I have no electricity supply available, I should also be glad of advice as to what form of power to use for driving the lathe. Will you also recommend a good book for a beginner in amateur lathe work?

W.H.B. (Churchill).

A wooden bench made as specified will be quite satisfactory for carrying the lathe and its countershaft. You do not state definitely whether you wish to use some form of mechanical power, or whether you propose to use [redacted] treadle. In the former case, the most practical alternative to an electric motor would be a small gas or petrol engine. If you wish to use a treadle, most lathe manufacturers can supply a suitable foot motor which could be attached to the bench.

We recommend the following books to give good practical instruction in lathe work. *The Beginners' Guide to the Lathe*, price 3s. 6d., *Practical Lessons in Metal Turning*, price 3s. 6d., and *The M.E. Lathe Manual*, price 12s. 6d. The latter is a comprehensive book dealing with all types of lathe work.

Cooling Model Petrol Engines

I am interested in constructing a petrol engine of 10-15 c.c. for use in a 48 in. cabin cruiser. I presume it should be water-cooled. Will you please inform me which of the engines listed in your plans catalogue, and corresponding with this capacity, are water-cooled. Also, please advise me of any firms who can supply castings and parts for these engines. I am particularly interested in the "Seal" and "Kittiwake" engines.

H.A.R. (Parkstone).

Most of the engines listed in our plans catalogue are of the air-cooled type, as there is at present very little demand for water-cooled engines. The only exceptions to this are the "Seal" engine, P.E.20, and the "Seagull" engine, P.E.25.

It is possible to convert air-cooled engines to water cooling by fitting [redacted] jacket in place of the fins on the cylinders. Air-cooled engines give quite good results for the purpose you have in mind, if equipped with a fan to maintain a flow of air over the cylinders.

Castings for the "Kiwi" and "Kittiwake" engines are supplied by Messrs. G. Kennion & Co. Ltd., 32, Kingsland Road, London, E.2, and for the "Ensign," "Seal" and "Seagull" by Craftsmanship Models Ltd., Norfolk Road Works, Ipswich.

The "M.E." Drilling Machine

Please give me particulars of the "M.E." drilling machine and also the names and addresses of firms who could supply castings.

F.B. (Redditch).

The "M.E." drilling machine is a simple three-speed machine with lever feed and provision for the fitting of a power countershaft. The pillar of the machine is a mild-steel shaft, 1 in. diameter, which may be of any desired length to suit the required capacity, and [redacted] circular swing table is fitted, allowing wide latitude of adjustment.

The maximum size of drill for which the machine is designed is $\frac{1}{4}$ in. Castings and parts for the construction of this machine can be obtained from W. H. Haselgrove, 1, Queensway, Petts Wood, Kent.

TWIN SISTERS

by J. I. AUSTEN-WALTON

THE oil tank is another of those "under-the-floor" items, and full details are given herewith. This introduces the big hole in the diaphragm as mentioned in the previous article; the object of this is to allow the main drain cock to project below, in a position where it may be operated easily, even when running on the track. Being well accustomed to running a great many hours at a stretch, I have made this tank large enough to supply oil for a running time of about 12 hours—I do not expect many people run for much longer than that. This suggested arrangement should enable you to drain and fill the oil tank before the day's operations, so that you should not have oil worries for the entire working period.

Waste Oil

I may have mentioned it before, but it is quite obvious that most locomotive men use far too much oil; that fringe of oil round the chimney shows that waste is taking place, and then the blower-ring, being sticky with it, starts to collect dust and ash until the whole bag of tricks gets hopelessly gummed up. I suppose this excess oil business means that the drivers are afraid of not getting enough in the cylinders, and so the lubricators are set to work on the generous side. This all leads up to the desirability of having a sight-feed that will enable you to see exactly how much oil is actually going along the feed pipe, then, there is just no doubt about it. For some time now I have been planning to put sight-feed fittings on other jobs already fitted with mechanical lubricators.

There are a number of snags with this sight-feed business, one of these being of a scale nature. But we will leave it at that for the moment, and in the next article the whole system will be detailed.

And now, let us get back to the oil tank as shown. This tank is of drum form, as it has to withstand pressure. Cut a piece of copper tube $1\frac{1}{4}$ in. diameter by about 16-gauge, to the required length, and turn up two thick end-plates to the drawing. These are a good push fit in the ends of the tube; smear them with flux, and knock them in. Prepare the supporting frame which entirely encircles the barrel, also making this a tight fit, and place on one side. Drill for the various bushes, inserting them in place, and try to silver-solder the whole issue in one heat. The alternative to this is to hard-solder or braze the two ends in, and later, silver-solder the remaining parts in place.

Continued from page 796, *Vol.* 107, *December* 18, 1952.

Testing

The finished unit should be tested under pressure, just like a miniature boiler. There is very little chance of the unit exploding as its proportions are more than adequate for the job, but the main thing is to ensure that it is steamtight. Once filled with oil and under pressure, a tiny blow-hole would very soon make everything in an appalling mess, and it would then be much more difficult to repair the leak, with so much oil in the pores of the metal and in the blow-hole itself. The other leakage danger spot is the filler cap. Give the bush that takes it a good flat top surface, and make a washer from "Hallite" or other reliable jointing material.

Builders have asked, more than once, why I so often fit plug caps with square heads. The reason is because, under the frequent application of a key or spanner, a hexagon shows signs of wear very much quicker. Have a plug well seized in, and try to remove it with an ordinary spanner, especially if the plug head is in brass or other soft metal; almost invariably, the hexagon gets torn to shreds, but the square head will withstand quite rough treatment.

If you take a look at the drawing you will notice that the two small unions are set out at distinct angles, but there is nothing critical about this. The top union looks as though it would be better placed right on top of the tank, but the cab floor comes right down to the level of the filler plug bush, and a nasty hump in the floor would look bad. In actual fact, the most that one can use of the tank space is from the bottom up to the lower level of the filler bush, after which an air lock forms and prevents further addition of oil or water. It would be an improvement to fit the top union with a tiny internal pipe that would reach up to that level; a scrap of copper pipe brazed into the union before insertion, would solve the problem.

The lower small union accepts a pipe through one of the existing openings in the rear diaphragm, so check up on this before you fix anything in place. The fixing of the tank is as shown, picking up with the existing bolts that hold the two brake shaft brackets underneath. Drill two more holes to provide a fixing, but above all, observe the conditions required to allow the rear drawbar to swing across the end, and over the extended foot of the oil tank frame.

The Pipe Runs

There is no need to worry about the actual pipe runs at this stage, but for your future information, this is the arrangement: The main steam regulator will be fitted with a tiny union in its base part; this union will only be "live" when the regulator is open. This is the main feed to the oil tank, and a pipe will run down the backhead, under the cab floor and rear diaphragm, and up to the lower small union on the tank. This length of pipe will ensure that it will be mainly water entering the tank, due to condensation. The top small union will carry the displaced oil up to the sight-feed fitting, situated on the bunker shelf, left-hand side; the pipe for this will be under the cab floor, turning upwards inside the bunker wing, and emerging through a hole in the shelf via the control valve. The lower large hole in the tank is for draining away the condensed water when the oil is exhausted. This is shown as a standard type of plug-cock, the main essential being that it should have a fairly large bore. There is not much chance of the usual "plug-cock trouble" being present, that is, the seized up condition; there will always be a lot of oil present in the tank, giving ideal lubrication to the valve.

Other Features

And now, let us consider some of the other features. Just suppose that when the engine is cooling off, a vacuum is created in the oil tank—a possibility. The system is so arranged that, in this eventuality and with the tank completely full

at the start, the sucked out oil cannot enter the boiler. The volume of the steam pipe is such that it would accept the entire contents of the oil tank before it could rise to a level sufficient to climb the main collection pipe in the dome. Apart from this, most of the oil would find its way down the steam pipe and to the cylinders direct. To replenish the oil tank when under steam, the regulator is of course shut, the drain cock under the tank is opened, thus releasing any pressure remaining, after which the filler cap may be removed and the oil poured in. Once the drain cock has been closed, and the cap tightened, you are ready once more to drive in the normal way.

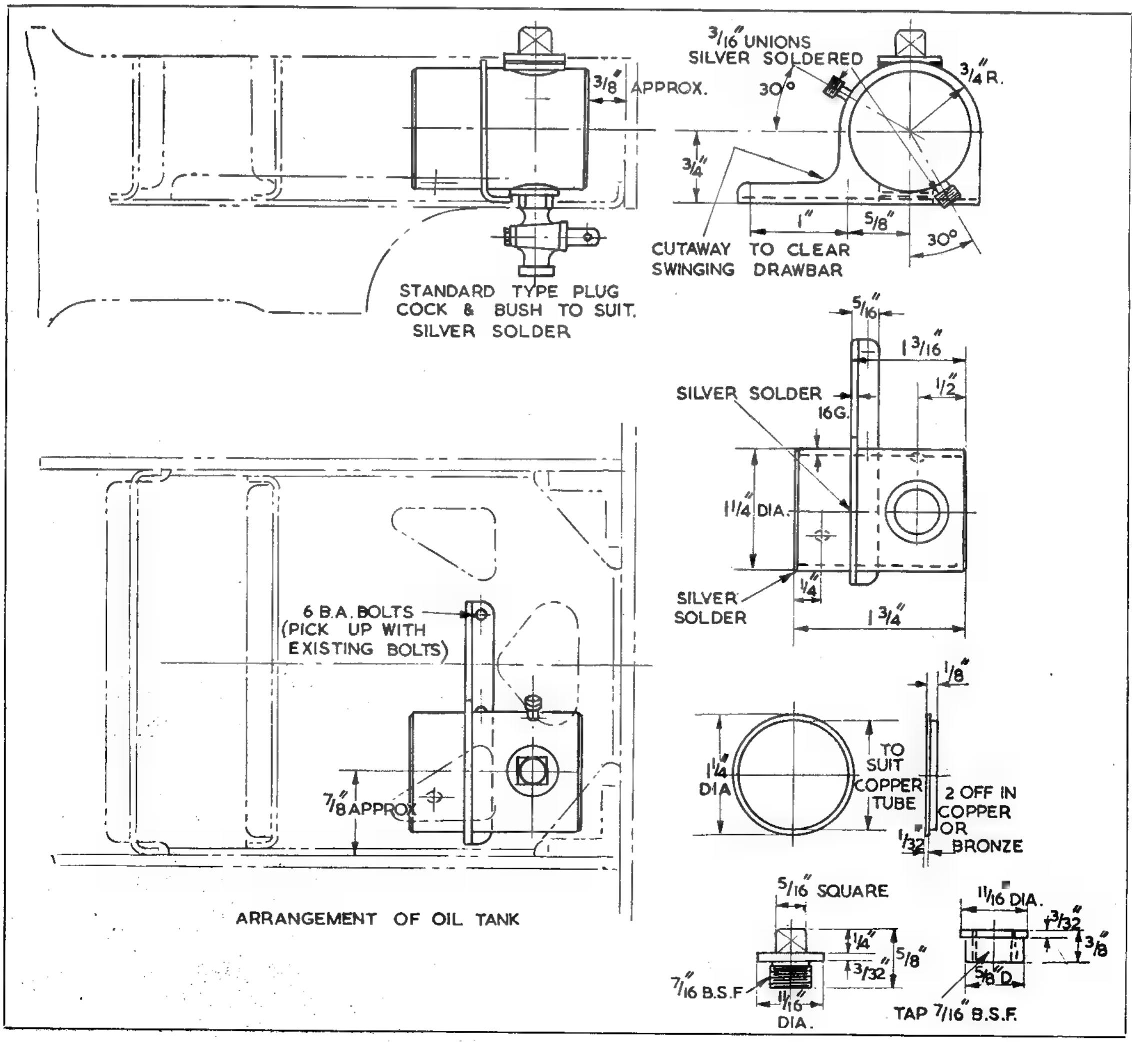
No Luck Yet

Whilst playing about with the rear diaphragm, drilling holes and suchlike, my thoughts turned to the possibility of fitting an emergency hand pump somewhere under the floor, and with its operating handle standing up in the bunker. I drew out several schemes, but there just does not seem to be room enough.

Don't take that to mean that it is given up; later on, I shall make a further attempt, when I have a little more time to spare.

Driving the engine is going to introduce some other problems as well. For one thing, coal has to be carried, and there is no room in the bunker once the back is taken out for driving access. The problem (as far as I am concerned) will be solved by making up a special truck with a forward-situated box to do the necessary. Those who have done much driving will know that it is possible to get *too close* to the cab for comfortable firing and manipulation of the controls; next time you are at a track meeting, notice how the tank engine drivers have to coil themselves up in order to get a decent view of the fire. With this in mind, the possibility of fitting a hand pump on the driving truck occurred to me. It would mean a short length of pressure hose, and an ordinary length of rubber tubing to connect to some suitable feed from the side tanks. Even the possibility of an additional water tank under the truck, need not be ruled out, and it might well add to the non-stop range of the engine in certain classes of trials.

Comfortable seating is another thing that is apt to be ignored on the driving truck. Most of the specimens I have seen consist of a



ARRANGEMENT OF OIL TANK

plain, varnished board which is not my idea of comfort. For some time now, I have cherished the possession of a motor-cycle pillion seat of the Moseley "float-on-air" type. This seems to have distinct possibilities, and when we get to the driving stage, I must report on it.

Leaf Springs

I still get odd reports of trouble with leaf springs, the main complaint being that they are too stiff. These troubles have been put right when the builders have removed one leaf from each "bank" of leaf lengths; and the conclusion reached is that, where clock spring has been used, two distinct snags crop up. The first of these is in the wide range of "tempers" (and possibly, steels) used in the industry. I have a large box of clockmakers' cast-away springs, and the other evening I went through it, examining the specimens for both temper and gauge. In a number of cases, the actual gauge was a matter for doubt. It may be that some of the Continental gauges happen to come about half-way between our own accepted sizes, and this was borne out when the micrometer was used to check them. If you get just about an extra "half-gauge" difference between a number of spring leaves, the cumulative extra stiffness in the made up spring, can have surprising results.

Tempers also seemed to vary to a large extent; one piece that was tried, snapped when bent through 120 deg.; another merely took on a permanent "set," and was altogether much softer. My advice is to select a brand of spring that will not break when bent back on itself, and if there is any doubt at all about the gauge, then either reduce the number of leaves called for on the drawing or choose a gauge that is quite definitely not above the required thickness. It *is* possible to calculate the degree of springing for any particular engine, such calculations being vindicated in the actual standing trim of my own "Sister." She stands on a perfectly even keel, and with all the adjustment range on the right side. I expect when she is watered up and the few tools are added that she may need slight adjustment, but this will almost certainly be at the back end where adjustment is easily and quickly carried out.

And how important this springing business is! I still contend that coil springing is rather too "lively" for some types of engines, with the result that slipping takes place, and that particular phenomenon annoys me more than anything else. To get away with a really big load, and the engine taking hold of it in a steady, measured style, is one of the greatest joys that one can experience.

(To be continued)

FOR THE BOOKSHELF

Teach Yourself Mechanical Draughtsmanship, by S. M. Hood. (London: English Universities Press Ltd.) Price 6s. Size 7 in. × 4½ in. 183 pages.

The "Teach Yourself" handbooks are well known to most students, and the present example conforms to the general standard of the series. It begins with a chapter on drawing equipment, followed by others on geometrical applications in engineering drawing, projection, pictorial drawing, conventional representations of standard components, specifications, limits and tolerances. The two final chapters deal with freehand drawing, and working drawings, respectively, with an appendix of useful data tables. A practical and informative book, which can be recommended to engineering apprentices and students.

Rewinding and Repair of Electric Motors, by Karl Wilkinson. (London: E. & F. Spon Ltd.) Price 20s. Size 9 in. × 5½ in., 208 pages.

This book is intended primarily to assist the small shop or individual craftsman in the repair and rewinding of small motors as used in industrial or domestic work. It is assumed that the reader has a working knowledge of basic electrical theory, and the information given shows how to copy the windings, and to rewind, existing machines, but not to redesign them, except for minor alterations of voltage, etc.; pure theory is avoided as much as possible. The illustrations include many line drawings, with the addition of eight half-tone plates, which are located at the end of the book; all are practical and to the point, but we are inclined to think that the author's stated intention of keeping the illustrations as simple as possible has been somewhat overdone, and more emphasis might have been given to them with advantage. Apart from this minor point, we have only praise for this highly practical book.

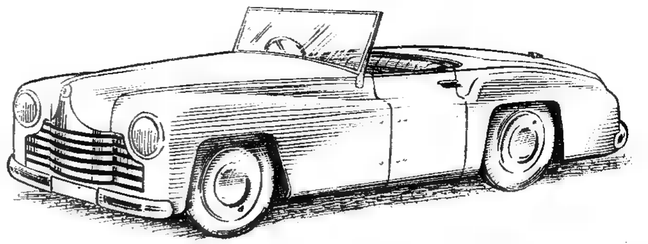
Modern Motorcars, by K. C. Hunt. (London: Temple Press Ltd.) Price 9s. 6d. Size 10 in. × 7½ in., 88 pages.

The latest addition to the Boys' "Power and Speed" Library, this book deals with the latest developments in motor car design, in an elementary manner well suited to the class of reader for which it is intended, but by no means below the notice of older readers. It is well illustrated, with numerous line drawings and several full-page plates in half-tone, and gives lucid explanations of the working and constructional features of engines, transmission systems, steering, suspension, braking, also chassis and bodywork. Controls and driving methods are explained, also tendencies in design of cars in various countries, and details of modern racing cars.

"Crusader": John Cobb's Jet Craft, by Colin Stewart. (London: Rolls House Publishing Co. Ltd.) Price 2s. 6d. 48 pages, 7½ in. × 4¾ in.

The tragic termination of *Crusader's* gallant attack on the world's water speed record, resulting in the death of a brilliant and intrepid pioneer, has given rise to much speculation as to whether this feverish quest for speed is worth while. This book does much to provide an answer to the question, or at least set the intelligent reader thinking it out for himself. Exploration into the unknown is never entirely in vain, and the knowledge gained in the design of fast water craft, and the application of jet propulsion thereto, which was obtained by John Cobb's last research, will undoubtedly be put to good use in the future. The history of fast speed boats is reviewed, and the principles underlying the design of record-breaking boats of the past, leading up to the design of *Crusader*, and the story of the tests. Numerous line drawings and photographs are included in the book.

A SPORTS CAR FOR THE YOUNGSTER



By

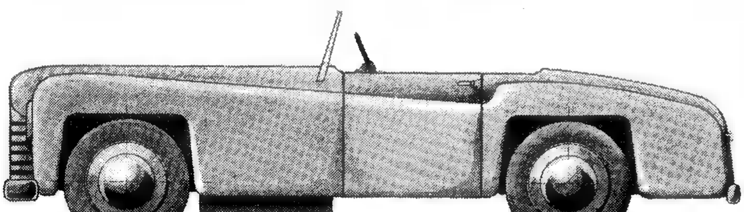
B. W. Francis

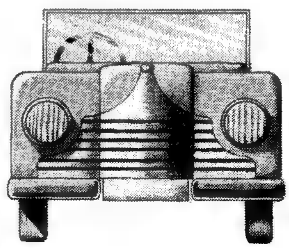
THE model Allard which I made in 1948 having proved satisfactory, caused me to consider making a similar model, yet different in some respects, chiefly in regard to the refinement of a reverse gear. This I wanted to do without adding to the number of controls, which meant that reverse gear and reversing of the motor must be selected by a column gear lever, the other controls being accelerator, foot brake and hand brake.

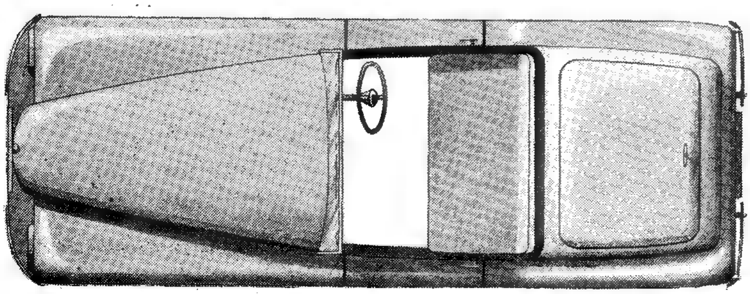
The similarity or otherwise of this car with the Allard can be seen by referring to the July, August and September 1948 issues of *The Model Car News*. My son was getting a bit too big for the sports two-seater, owing to the fact that the distance between the scuttle and seat is restricted on this type of body, unless scale proportions are ignored, so I decided to make a type which is sometimes called an occasional four; thus, the body would look in proportion, yet, by having only one adjustable seat, there would be plenty of room for a short or tall driver.

Having studied various makes and styles, I struck a compromise by copying the side and rear aspects of the Healey Sportsmobile and front end of the Singer 1500. The car is about the same size as the Allard and all measurements are worked out from the wheel diameter, which is 12$\frac{1}{8}$ in. Side, front, rear and plan views were first drawn to 1/5th full size, then stepped up to full size. I could not get card large enough for this, so I made do by sticking together pieces of 30 in. × 20 in., three pieces doing for side and plan elevations and one each for front and rear. Two sets of plans would be better, as I cut up various pieces for templates, but I managed without.

The sides of the wings were the first pieces made, by cutting out the shape as shown (Fig. 1) from card patterns, then tracing round the edges on to sheet iron. All iron used in the model is 24-g., this being the lightest gauge that I have found workable. Before cutting out, some alterations must be made to size as follows: Edges *A*, *B*, *C*, *D* and corner *E* are rounded to make a $\frac{1}{8}$-in. circle, therefore these edges will be taking a short cut and will be shorter than appears on the side view alone. How much shorter can be ascertained by measuring the front edges of the wings to half way round the curve in the front view drawing (Fig. 2). For wheel arches and the bottom of the body I allowed an extra $\frac{1}{4}$ in. to compensate for turning over to make ■ strong and smooth edge, although eventually the body was curved and the bottom edge was a steady bend of 1 in. radius. Having made two identical pieces thus, the next were those that formed the top, front and rear of the wings. This strip had to







Our artist's three-view drawings of Mr. Francis's electrically-driven model sports car, show well its clean modern lines, based mainly on the styling of the Healey Sportsmobile

be made in two lengths, being about 8 ft. 6 in. long, and my sheets were 6 ft. × 3 in. only. The join was made somewhere about half way along the front wing. To avoid warping, I did not weld the seam, but tinned and plated it underneath. Part of this shaped piece can be cut from the plan view, bearing in mind the curves at *F*. The front and rear pieces can be measured in length by the side view, and for width by referring to front and rear drawings. This piece stretches from *A* round to about *G*. Before cutting it out, an allowance of an extra $\frac{1}{2}$ in. was made on the body side reduced to $\frac{1}{4}$ in. at sharp corners, to be bent over at right-angles and the edges eventually welded to the body. The meeting edges of these two pieces were beaten out over formers, so that, when placed together, they butted.

On the right is the car described in this article—an earlier effort is on the left

I made three dollies for forming all bodywork, see sketch Fig. 3. Two like *A* and one like *B*. *A* was a piece of 2-in. water pipe welded to a smaller piece long enough to fix in the vice when required; the other *A* was a piece of 1-in. pipe. *B* was turned from a solid piece of steel shafting. The large *A* was used for all wings and body edges, the small one for the rear boot and *B* for all corners. I also made a special hammer by welding a 1-in. steel ball to a piece of $\frac{1}{2}$-in. steel rod and $\frac{3}{4}$-in. conduit for a handle. Welding these pieces together was tricky and alarming, as directly the torch was applied, the parts warped terribly and the whole assembly looked a complete mess when finished; but after about an hour with hammers and dollies, some order appeared and a satisfactory result was obtained.

The method used for welding the seams was to tack at 2 in. spaces, then 1 in. and finally fill in the remainder.

The bonnet was next made (Fig. 4). The side piece has to go partly around the front (the joint where both sides meet need not be good, as the "cowling" eventually covers all of it). As there is considerable panel beating on the top piece, due to stretching and shrinkage, I took by final measurements for the side pieces from it and did not rely on drawing alone. The tail or boot was next made in a similar manner, this being the easiest section to form. The "lid" was not cut out at this stage. Side pieces on this section were extended to meet the end of the bonnet (Fig. 5). Now, if all parts are according to drawings, the sides, bonnet and boot can be clamped together with several small hand vices, checking for squareness all the time. The edges only of meeting pieces were welded by holding the torch sideways to avoid warping (Fig. 6). The boot lid was then cut out with a chisel and the edges bent down to form a seating for the lid. A piece of $\frac{1}{8}$-in. welding rod was rolled in, all around the cockpit.

Attention was now given to the chassis, this consisting almost wholly of $\frac{1}{2}$-in. conduit tubing, with the seams welded where necessary. The two main side members are parallel for a distance to enable the seat to be adjusted, and are arched to clear the rear axle. At various points there are bracing-pieces to the body to help in making the model absolutely rigid, yet light and square. The front suspension is independent by split axle and coil spring (car valve

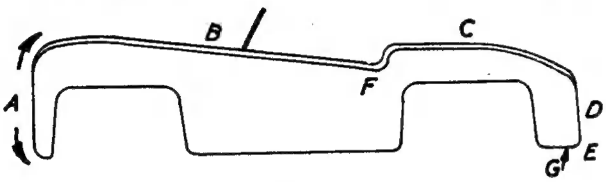


Fig. 1

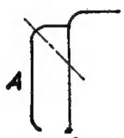


Fig. 2

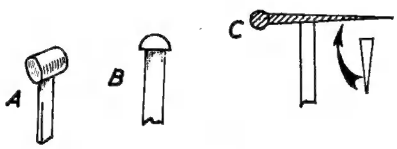


Fig. 3

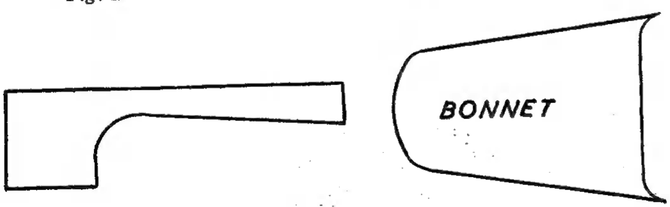


Fig. 4

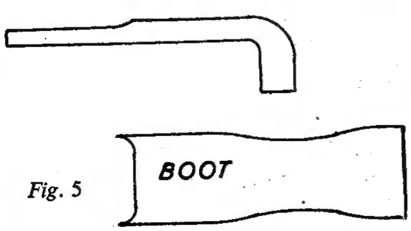


Fig. 5

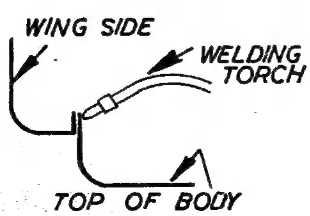


Fig. 6

springs). Track rod and drag link ends are throttle swivel ball joints (Fig. 7.) The steering box was made from parts of a Sturmey Archer hub (Fig. 8), a gear ring and a planet pinion. The gear ring was softened, then cut so that only the ring with internal teeth remained. A washer was welded to this and a $\frac{1}{4}$-in. hole made in the centre of it. A bearing, consisting of $\frac{1}{2}$ in. of $\frac{1}{4}$ in. diameter tube was welded to the washer. A piece of $\frac{7}{16}$ in. diameter steel rod was turned to fit the inside of the pinion and brazed to it to form the steering column shaft. This was afterwards drilled $\frac{3}{16}$ in. so that the column could be clamped to it. The column itself is $\frac{1}{2}$-in. conduit, seam welded. The box supporting bracket is a piece of sheet-iron, with edges turned over and strengthened where the shaft goes through. The steering wheel was made from split steel curtain rod, formed by bending around a suitably sized pulley wheel, join welded and further trued on the pulley. The spokes are just sheet, centre a $1\frac{1}{2}$ in. diameter washer with a funnel shaped piece welded on (Fig. 9).

Although the rear axle has to take nearly all the weight, including the battery, mechanism and most of the driver's weight, I found $\frac{3}{4}$-in. conduit quite strong enough. There is no differential, one wheel being left free on the shaft and the other bolted through. Two LK-bearings were used for the axle, encased in housings made from shelter laths; these also act as radius rods. Silentbloc ends were made by wrapping a piece of motor tube under the arms before clamping. The two M/C spokes at a tangent are to prevent side movement, and work effectively, as neither chain has ever come off since fitting. All pieces forming the chassis for the drive and motor, etc., are $\frac{3}{4}$-in. conduit. The photograph shows the main chain adjustment and the motor swivels to adjust the primary chain.

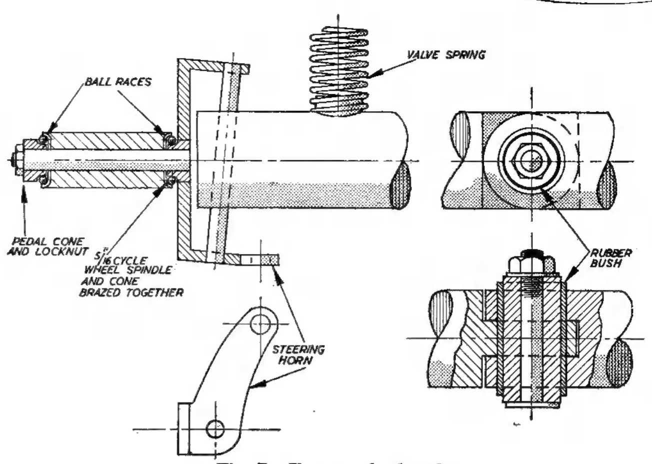


Fig. 7. Front axle details

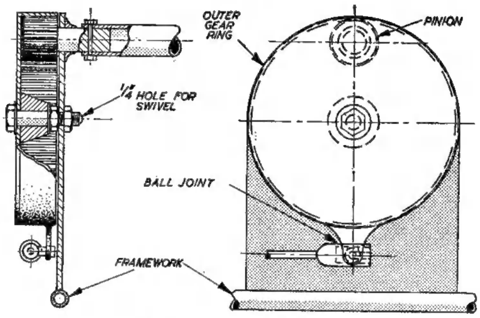


Fig. 8. Steering box

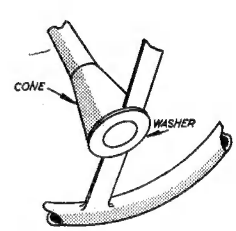
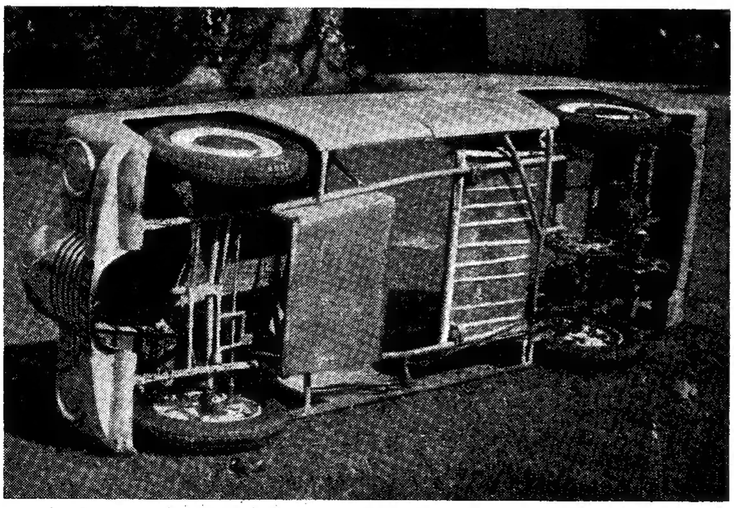


Fig. 9. Steering wheel



Photograph of the underside, showing the steering and driving mechanism

The motor is a 12 V starter motor from an Austin 12 h.p. car. I altered this unit in the following manner: The end supporting case was discarded and the shaft cut off, leaving a thin, supporting centre bearing. To avoid friction I made a housing to take a small ball-bearing $1\frac{5}{8}$ in. $\times$ $\frac{1}{2}$ in. $\times$ $\frac{5}{16}$ in., which fitted the shaft, and this was bolted to the plate. By mounting the driving sprocket right up to the motor, it meant that the latter was running practically on this bearing alone, as the further end of the shaft would tend to lift and run very lightly on its plain bush end (Fig. 10). The large chain wheel on the S/A hub was brazed to the driving dog after turning out the centre to slip over the threaded end of the dog. The small sprocket was likewise brazed on to the housing at the other end. As the housing is threaded L.H., it follows that this tends to unscrew when the drive is applied; this was locked by making two notches (diametrically opposite) in the housing, making two pegs to engage these notches and enlarging two hub holes to take 5/32 in. bolts.

(*To be continued*)

READERS' LETTERS

Letters of general interest on all subjects relating to model engineering are welcomed. A nom-de-plume may be used if desired, but the name and address of the sender must accompany the letter. The Managing Editor does not accept responsibility for the views expressed by correspondents.

MAKING A MICROMETER

DEAR SIR,—I have been privileged with the loan of a number of copies of THE MODEL ENGINEER, published during the war, and among these was the series by "Ned" on the construction of a micrometer. The articles appealed so much to me that I immediately decided to try one; I have a 0-1 in. micrometer and so the obvious choice was a 1 in.-2 in. size.

After studying the series, I decided on where my methods would vary, and now the job is complete I am quite satisfied with the result.

The frame was cut to shape from a piece of $\frac{1}{4}$ in. black plate, approx. 0.010 in. oversize in thickness, and a boss $\frac{9}{16}$ in. dia. welded in place. This part was then left in the kitchen fire overnight, in order to remove all stresses set up in the welding, etc. After cleaning off the scale, the bottom edge was filed smooth, and, using this as a datum face, the centre-line was scribed around the boss and the other side where the anvil fits. A further centre-line was scribed at right-angles to this, by laying the frame flat on a packing block and taking the centre as half the thickness of the frame.

A light centre-pop was made at each end on the crossed lines and the frame was put between centres on the lathe while an angle-plate was clamped to it and the faceplate. This ensured the true running of both centre-lines, and the live centre acted as a thrust-bearing and guide to prevent the frame shifting under the clamp while drilling, tapping, etc. When the frame was mounted on a stub mandrel screwed $\frac{1}{8}$ in. B.S.P. to suit. The centre-pop for the anvil hole ran perfectly true, thus "proving" the alignment, and this was then drilled and tapped 5/32 in. × 40 t.p.i.

I think this a much more reliable method than leaving the frame solid and drilling right through from one side with all the risk of the drill running off.

The remainder was done as per instructions, except that I used silver-steel for the screw, finished the thread with a die by hand and I used $\frac{5}{16}$ in. × 40 and $\frac{1}{4}$ in. dia. for the plain, as in my own micrometer, because I have the taps, die and reamer.

The whole job has been a very pleasant task, and the processes involved have left my lathe a better machine in the bargain, as I now have an expanding mandrel for using gears to index the lathe mandrel and an index on the leadscrew, both of which were necessary and had long been on my list of "wants." Also, I have made a lot of overdue adjustments which were, of course, vital to the job in hand. Finally, I would like to say "thank you" to "Ned," and all those others whose work and inspiration go to make THE MODEL ENGINEER so very welcome when I come home from work on a Thursday evening.

Yours faithfully,
F. T. LEIGHTWOOD.
Newcastle-on-Tyne.

Re HAND SCRAPING

DEAR SIR,—May I, as the mere author of the article concerned, have a few paragraphs on the subject of the letters from Mr. K. A. Hellon and Mr. G. Upton which have appeared in THE MODEL ENGINEER?

Let me say at once that I am not the least concerned as to whether the type of scraper I advocate, or the more orthodox type, is the better, because a brief trial with both would settle the question for ever.

What does interest me, however, is the fact that Mr. Hellon's letter is a beautiful example of a common fallacy; namely, the belief that if two techniques differ, one of them must be wrong. I am also intrigued by the logic employed.

When Mr. Hellon's first letter appeared in print, all my friends wanted to know if I would write an answer to it. I said that I would not, because there was nothing to make answer to. This will be evident when the basis upon which Mr. Hellon criticises my scraper is examined; viz. that neither he, nor his friends, nor the large tool dealers in London, *have ever seen it, let alone used it*. With all due respect, I submit that this is not a good basis upon which to form an opinion.

On the other hand, Mr. G. Upton, who speaks favourably about the type of scraper which I advocate, has used all types in his profession as a machine-tool fitter. It seems possible that his is the more useful contribution.

Yours faithfully,
LAWRENCE H. SPAREY.
London, N.20.

MODEL PETROL ENGINE VALVE GEAR

DEAR SIR,—I was very interested to read Mr. Westbury's comments in the November 27th issue of THE MODEL ENGINEER regarding the engine of my model hydroplane, but I should like to answer his criticism regarding the valve springs. The engine has, as was stated on the entry form, an experimental "double knocker" mechanism, which positively operates the valves at all stages of their operation. Reference to the photograph on page 698 clearly shows that the rocker arm does not bear on the end of the valve stem, but lies between a pair of washers on the stem. It is, therefore, able to close the valve and hold it closed, this being accomplished by the addition of a second cam and push-rod. The valve does not, therefore, have to overcome the total inertia of the valve, its main function being to account for a probable differential expansion of the cylinder, etc., and the push-rods, and take up backlash in the mechanism.

The apparent advantages of this design are that valve bounce at high speed is eliminated, and longer periods of dwell in the open position can be used, without increasing the cam loading.

The engine has been run at moderate speeds, but whether the apparent advantages will be realised at high speed has yet to be seen.

Yours faithfully,
London, S.E. K. W. CHAPPELL.

"OWD ANN"

DEAR SIR,—In response to your appeal for information on the engine at Wigan, referred to by the *Liverpool Echo*, I give these few scanty details from personal observation. In 1918, I was a furnace boy at the works mentioned (Ince Forge). I place this date by the fact of a Zeppelin raid on Wigan in that year, and I well remember the engine referred to; as stated, it was a

four-wheeler with vertical boiler, twin-cylinder vertical engine geared to the driving axle.

I always understood that this was one of the engines that worked on the Wigan Tramways before they were electrified. I regret that I cannot recall the name of the makers, but it is surely a credit to them that it should be working for so long.

Yours faithfully,

Southport. T. WARD.

DEAR SIR,—With reference to the enquiry in "Smoke Rings" in your November 27th issue, I think the 0-4-0T locomotive at Ince Forge, Wigan, is probably that described on page 269 *et seq.* of *The Railway Magazine* for April, 1939. (Vol. 84, No. 502.)

For those readers who may not have access to this article, I summarise the information as follows :—

This engine was built as a "steam tramway locomotive" in 1886 by Beyer Peacock & Co., for the Manchester, Bury, Rochdale and Oldham Steam Tramways Co., and is the sole survivor of four engines, Nos. 83 to 86. (Maker's numbers 2733-6.)

These worked the Oldham Borough lines until electrification took place, in 1904 ; three were then sold (in 1905) to the Ince Forge Co., who subsequently resold two, and retained one, believed to be No. 84. (The building plates are understood to have been removed.)

Boiler and engine are vertical ; the original boiler, stated to be of the Field type, was renewed in the early 1930s, and now work at 140 lb. sq. in.

There are two simple cylinders, 8 in. dia. by 11 in. stroke, driving an intermediate crankshaft, from which the final drive is by 22-tooth pinion to 36-tooth spur wheel. The four 2 ft. 6 in. diameter wheels are coupled by outside locomotive-type coupling-rods, the wheelbase being 5 ft. 8 in.

A condenser was originally fitted on the roof, but this has been removed, together with most of the guard sheeting round wheels and cab. The main frames have been strengthened, to withstand shunting shocks, and the controls modified, but otherwise the locomotive is substantially in its original condition.

May I also suggest that our very good friend, "L.B.S.C.", might, at some future date, give us the benefit of his experience, and produce "Annette" as a sister to "Juliet" and "Tich"?

Yours faithfully,

Grantham. S. L. REDSHAW.

WITH THE CLUBS

The Society of Model and Experimental Engineers

Mr. J. E. R. Wuidart, of the North London Society, who gave a very interesting lecture at the Caxton Hall, on Saturday, December 13th, on "Hardening and Tempering of Small Tools," has very kindly consented to follow up this with a practical demonstration on the same subject. This will take place at 28, Wanless Road, S.E.24, on Saturday, January 10th, 1953, at 2.30 p.m. Visitors will be welcome.

Full particulars of the society may be obtained from the Secretary, E. C. YALDEN, 31, Longdon Wood, Kent.

Tonbridge Model Engineering Society

Mr. E. M. Graville presided at the general meeting held on December 6th.

Attendance was rather low, owing to difficulties of travel caused by the fog, but Mr. Portlock gave a very instructive talk on fire extinguishers and their uses.

The chairman then gave a report of the proposed future activities of the society, as discussed at the previous committee meeting, and proceedings finished with a vote of thanks to Mr. Portlock.

Hon. Secretary : R. H. PROCTER, Roslyn, Coldharbour Lane, Hildenborough.

York City and District Society of Model Engineers

The first meeting of the New Year, 1953, will be held on Wednesday, January 7th, at 7 p.m., in The Rechabite Building, Clifford Street, York. It is hoped that the new arrangement will enable more members to attend meetings which will in future be held on alternate Wednesday evenings the second for January being on the 21st.

Ex-members will be specially welcome.

Hon. Secretary : W. SHEARMAN, 28, Terry Street, York.

The Tees-side Society of Model and Experimental Engineers

On Tuesday evening, December 9th, 1952, there was held at Middlesbrough what is known as a "Bits and Pieces" night or, more grammatically, a meeting at which members produce any models, components and tools they have in progress, for the inspection, criticism, admiration or envy of their fellow members. Several such items were produced and promoted interesting discussions. One in particular did arouse much envy ; this was a very nicely finished example of the twist drill grinding jig described in THE MODEL ENGINEER some months ago, and submitted by Mr. Reid.

Hon. Secretary : J. W. CARTER. 28, East Avenue, Billingham, Co. Durham.

The Wolverhampton Model Engineering Society

An enjoyable "Bits and Pieces" evening was held on December 2nd in the study of the Wolverhampton Public Libraries, at which the attendance was very satisfactory considering the poor weather.

On January 6th, 1953, we will be holding our annual general meeting in the study of the libraries as above, commencing at 7.30 p.m. prompt. The entrance open for the society use is the side door in Garrick Street.

Hon. Secretary : J. P. S. JONES, 6, Alexandra Road, Penn, Wolverhampton.

South London Model Engineering Society

The first meeting in the New Year will be held on Sunday, January 4th, at 11 a.m., at the White Horse Hotel, Brixton Hill, S.W., and will be "Any Questions." Mr. Rowland in the chair, supported by Messrs. Davidson, Phillips, Philpot and Dunbar.

Saturday, January 24th, at 7 p.m., the locomotive section are having their night when Mr. Philpot will be in the chair. Mr. D. C. Bank will give a cine show of locomotive interest.

Hon. Secretary : W. R. COOK, 103, Engleheart Road, Catford, S.E.6.

The Annual Subscription is £2 2s. 0d., post free, to all parts of the world.

The Managing Editor invites correspondence and original contributions on all small power engineering and electrical subjects. Correspondence and manuscripts should not be addressed to individuals, but to the Managing Editor, THE MODEL ENGINEER, 19-20, Noel Street, London, W.1.